Pronghorn, sheep and cattle range relationships in Carter County, Montana
by Roy Bruce Campbell

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

Abstract:
A study of pronghorn-livestock range relationships was conducted in Carter County, Montana during the summer of 1968 and from April to September, 1969. Six habitat types were distinguished. Vegetation was evaluated on four habitat types and on certain sheep pastures. Lower values for forb abundance were recorded on sheep pastures than on non-sheep pastures. Classification as to age and sex of 5,000 individual pronghorn observations indicated a summer composition of 26.6 percent males, 44.7 percent females and 28.7 percent fawns. Pronghorn densities for summer and early fall of 1968 and late spring, summer and early fall of 1969 were 2.7, 3.0, 2.2, 2.6 and 2.9, respectively. Biological data were obtained from each of 12 pronghorns collected. Weights of males continued to increase up to age 4. Physical condition indexes - showed an increase in body condition from April to September. Fences were classified in relation to pronghorn passability. Pronghorn distribution and movements were not significantly influenced by fence type, probably due to fence condition and/or open gates. Home range sizes were determined for 16 individually recognizable pronghorns. Statistical tests indicated no real difference between home range sizes of the three groups — "bachelor" males, female associations, and territorial males — however, other factors probably influenced the outcome of the tests. Pronghorn distribution, as determined from 5,000 individual pronghorn and 577 group observations was tested statistically for randomness in relation to habitat type. These tests indicated that distribution was not random and that group classification may be more meaningful as concerns evaluation of habitat use. Pronghorn group distribution was influenced by condition of vegetation, human activity, livestock use, arid past grazing history of pastures. Livestock distribution was governed by the rancher and fences. Pasture use and association data indicated a compatible prong-, horn-cattle relationship, but a non-compatible pronghorn-sheep relationship. Feeding site examinations for pronghorns, sheep, and cattle and analyses of 13 rumens from pronghorns provided food habits data. Forbs were the dominant items in the pronghorns diet all three seasons, Shrub use was greatest for spring and fall and grass use was insignificant all three seasons. Shrubs were the major items in the spring diet of sheep, whereas grasses dominated for summer and fall; Grasses were dominant all three seasons in the diet of cattle. Forb usage was. greatest for spring and summer. Shrub use was insignificant all three seasons. Agropyron smithii was the major grass used by cattle and sheep. Artemisia tridentata was preferred by pronghorns and sheep in the spring. Melilotus officinalis was preferred by pronghorns, sheep and cattle whenever available. Pronghorns generally preferred range plants with the highest crude protein levels. A progressive seasonal decline in crude protein content was noted for all plants analyzed. The low use by pronghorns for all three seasons of pastures occupied by sheep precluded any severe direct forage competition even though similarities existed in the diets. The most important aspect of pronghorn-sheep competition was the non-compatible relationship between the two which resulted in pronghorn withdrawal from 14.7 percent of the study area. Differences in pronghorn-cattle food habits and the compatible relationship between the two indicated that joint range use occurred, and as a result more efficient range use was achieved.

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by

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A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Fish and Wildlife Management

Approved:

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MONTANA STATE UNIVERSITY
Bozeman, Montana

August, 1970

ACKNOWLEDGMENT

I wish to extend my sincere appreciation to the following for their cooperation and/or assistance during the study: Dr. Don C. Quimby, Montana State University, for technical assistance during the study and for guidance and suggestions in preparation of the manuscript; Dr. Robert L. Eng and Dr. Richard E. Graham, Montana State University, for critical reading of the manuscript; Mr. H. O. Compton, Montana Fish and Game Department for project planning; Dr. W. E. Booth, Montana State University for verification of plant specimens; Mr. Thomas W. Mussehl and Mr. Kenneth R. Greer, Montana Fish and Game Department, for providing facilities and assistance during various stages of the study; personnel of the Bureau of Land Management, Miles City, Montana; U. S. Department of Agriculture ASCS and SCS personnel, Ekalaka, Montana for cooperation and assistance; Dr. Richard E. Lund, Montana State University, for consultation on statistical analyses; the ranchers on the study area for their cooperation and assistance without which this study would not have been possible; and to my wife, Marlynn, for encouragement, patience and assistance. I was employed by the Montana Fish and Game Department under Federal Aid Projects W-98-R-9, W-98-R-10, and W-98-R-11.

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ABSTRACT

A study of pronghorn-livestock range relationships was conducted in Carter County, Montana during the summer of 1968 and from April to September, 1969. Six habitat types were distinguished. Vegetation was evaluated on four habitat types and on certain sheep pastures. Lower values for forb abundance were recorded on sheep pastures than on non-sheep pastures. Classification as to age and sex of 5,000 individual pronghorn observations indicated a summer composition of 26.6 percent males, 44.7 percent females and 28.7 percent fawns. Pronghorn densities for summer and early fall of 1968 and late spring, summer and early fall of 1969 were 2.7, 3.0, 2.2, 2.6 and 2.9, respectively. Biological data were obtained from each of 12 pronghorns collected. Weights of males continued to increase up to age 4. Physical condition indexes showed an increase in body condition from April to September. Fences were classified in relation to pronghorn passability. Pronghorn distribution and movements were not significantly influenced by fence type, probably due to fence condition and/or open gates. Home range sizes were determined for 16 individually recognizable pronghorns. Statistical tests indicated no real difference between home range sizes of the three groups -- "bachelor" males, female associations, and territorial males -- however, other factors probably influenced the outcome of the tests. Pronghorn distribution, as determined from 5,000 individual pronghorn and 577 group observations was tested statistically for randomness in relation to habitat type. These tests indicated that distribution was not random and that group classification may be more meaningful as concerns evaluation of habitat use. Pronghorn group distribution was influenced by condition of vegetation, human activity, livestock use, and past grazing history of pastures. Livestock distribution was governed by the rancher and fences. Pasture use and association data indicated a compatible pronghorn-cattle relationship, but a non-compatible pronghorn-sheep relationship. Feeding site examinations for pronghorns, sheep, and cattle and analyses of 13 rumens from pronghorns provided food habits data. Forbs were the dominant items in the pronghorns diet all three seasons. Shrub use was greatest for spring and fall and grass use was insignificant all three seasons. Shrubs were the major items in the spring diet of sheep, whereas grasses dominated for summer and fall. Grasses were dominant all three seasons in the diet of cattle. Forb usage was greatest for spring and summer. Shrub use was insignificant all three seasons. *Agropyron smithii* was the major grass used by cattle and sheep. *Artemisia tridentata* was preferred by pronghorns and sheep in the spring. *Melilotus officinalis* was preferred by pronghorns, sheep and cattle whenever available. Pronghorns generally preferred range

plants with the highest crude protein levels. A progressive seasonal decline in crude protein content was noted for all plants analyzed. The low use by pronghorns for all three seasons of pastures occupied by sheep precluded any severe direct forage competition even though similarities existed in the diets. The most important aspect of pronghorn-sheep competition was the non-compatible relationship between the two which resulted in pronghorn withdrawal from 14.7 percent of the study area. Differences in pronghorn-cattle food habits and the compatible relationship between the two indicated that joint range use occurred, and as a result more efficient range use was achieved.

INTRODUCTION

Pronghorn antelope (*Antilocapra americana*) have been present in southeastern Montana for many years. Nelson (1925) did not include Carter County among the areas populated by pronghorns in 1922-24, although Powder River, an adjoining county, was listed as having the highest density in the State. Beer (1944) listed the pronghorn population of Carter County as being 2,500, the highest among the counties inhabited by pronghorns. This figure did not include bands that reportedly came in from South Dakota during severe winters to winter in the breaks and buttes along the Little Missouri River. Surveys by personnel of the Montana Fish and Game Department have indicated densities per square mile of 1.04, 1.54, 0.85 and 1.88 for a portion of Carter County which included my study area for the years, 1950, 1955, 1959 and 1965, respectively.

Following the passage of the Taylor Grazing Act in 1934, the migrations mentioned by Beer (1944) were probably curtailed by extensive fence construction that began in the area in the 1930's. New pastures were formed and the few existing pastures were sub-divided by additional fences, many of which were sheep-tight. Stock ponds were constructed and carrying capacities for livestock were established for public lands. Pronghorns were not considered.

Food habits of the pronghorn for fall in Carter County were reported by Couey (1946) and Buck (1947). Both pointed out the importance of

sagebrush (*Artemisia* spp.), and Buck (1947) indicated that pronghorns compete very little with cattle. Outstanding among the reports in general on pronghorn-livestock competition are those by Severson *et al.* (1968) and Buechner (1950) and (1947).

The intensification of game management in recent years, the deficiency of basic information on pronghorn-livestock range relationships, and the importance of Carter County as a producer of pronghorns lead to the initiation of the present study. This study included the food habits of pronghorns, sheep (*Ovis aries*) and cattle (*Bos taurus*) on a common-use range during late spring, summer and early fall; an evaluation of interspecific range use relationships and pronghorn movements and distribution in relation to fence types and cattle and sheep use of the area. Full-time field work was carried out during part of the summer of 1968 and from April through September, 1969.

DESCRIPTION OF AREA

The study area (Figure 1) of approximately 40,631 acres of publicly and 55,115 acres of privately-owned lands (Figure 18, Appendix) is in extreme southeastern Montana. It is included in the western half of the Little Missouri River Drainage Basin in Carter County. It is bordered on the north by Sheep Mountain, on the west by the Finger Buttes, on the southwest by Blacktail Creek and on the southeast by the county road which parallels the Little Missouri River. The principal drainages are Hackberry, Cottonwood, and Blacktail Creeks. The economy is primarily based on livestock production and forage-producing crops of native hay, alfalfa, and grain.

Physiographic features are broad sloping plains covered with sagebrush and sporadically broken by coulees which on the north and west sides of the area are bordered by shale hills and buttes topped with stands of *Pinus ponderosa*. These stands grade into scattered patches of *Symphoricarpos occidentalis*, *Prunus virginiana*, and *Shepherdia argentea* thickets about midway from the top which in turn give way to *Sarcobatus vermiculatus-Artemisia* spp. "badlands" near the bottoms of the hills. From mid-summer on, the only areas that appear verdant are the bottoms of the drainages (Figure 2) and certain protected areas in the hills and buttes bordering portions of the study area.

Exposed rock formations are of sedimentary marine and continental origin, ranging in age from upper Jurassic to present (BLM Land planning and Classification Report 1959). Very little crustal disturbance

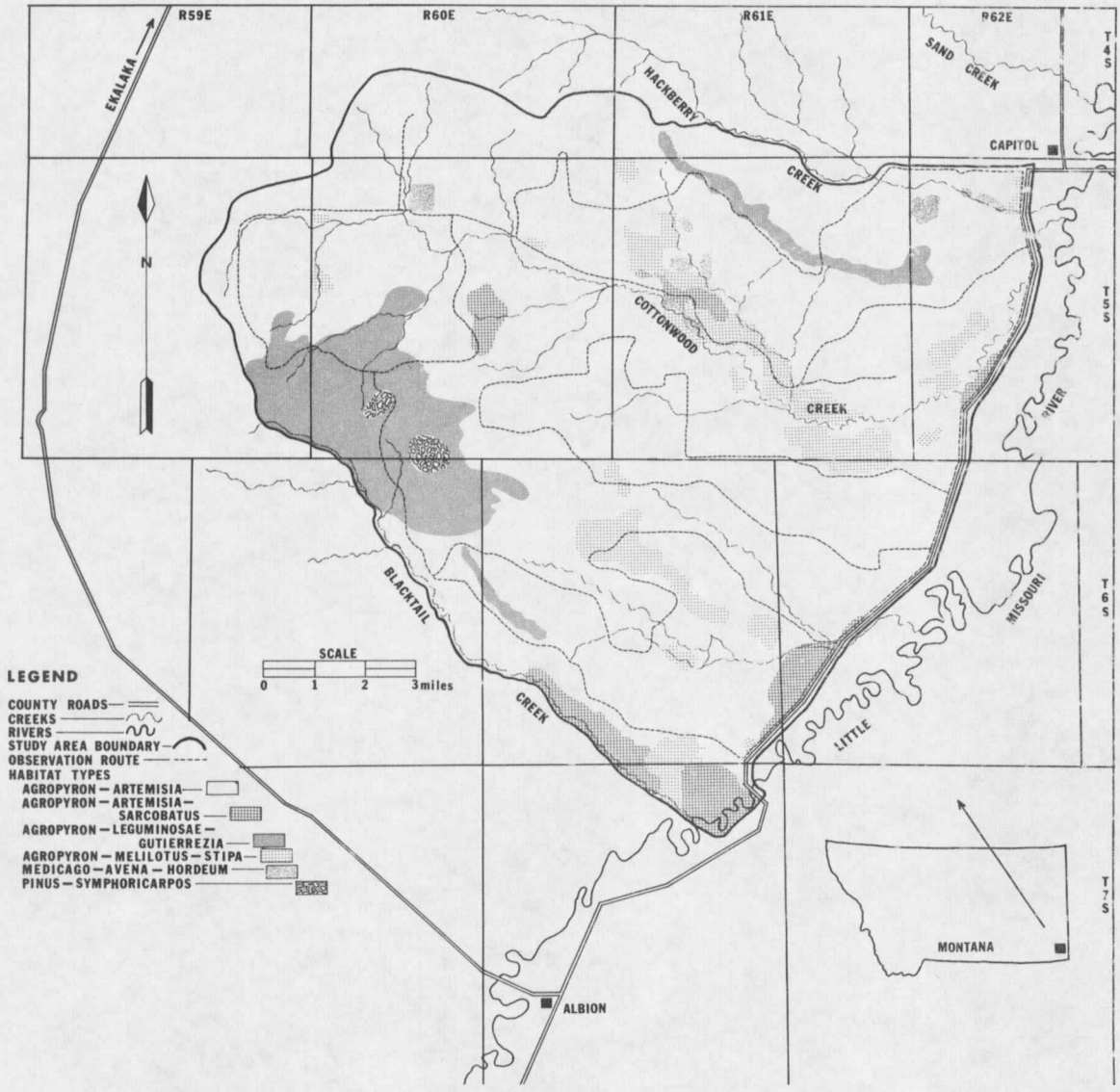

Figure 1. Study area showing the vehicle observation route and distribution of habitat types.

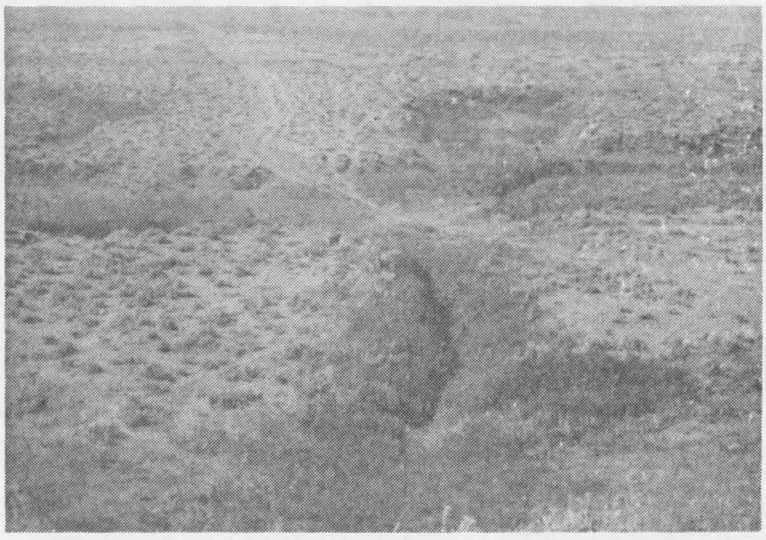

Figure 2. *Agropyron-Artemisia* habitat type showing verdant coulees.

has resulted in most of the rock outcroppings dipping very gently if at all. Soil on most of the area is thin and poorly developed except for flood plains along major drainages where some fairly deep and well-developed soils are found.

Sandstone outcroppings in the extreme northeast portion have produced the only sandy to loamy soils. Shale formations over most of the remaining area have resulted in soils of the clay or clay loam type. Scattered clay pan spots, with a Solonetz profile, occur throughout the area on the broad sloping flats between drainages. Around the bases of hills and buttes on the west and north edges of the area numerous Solonchaks (puff spots) are encountered. These unusual soil features (Figure 3) have resulted from soluble salt percolation in a poorly drained silty clay loam soil type (BLM, Land Planning and Classification Report 1959).

Monthly climatological data for 1968 and 1969 for the study area (Table 18, Appendix) were obtained by averaging the records from the United States Department of Commerce Weather Stations at Albion, at the southeast edge, and Ridgeway, a few miles outside of the northwest edge. The average temperature in 1969 for April and May was 51.8 F and for June, July and August, 66.7 F. These were 8.1 percent above and 0.7 percent below the 10-year means, respectively. Average precipitation in 1969 for spring was 1.14 and for summer 2.40 inches. These were 38.4

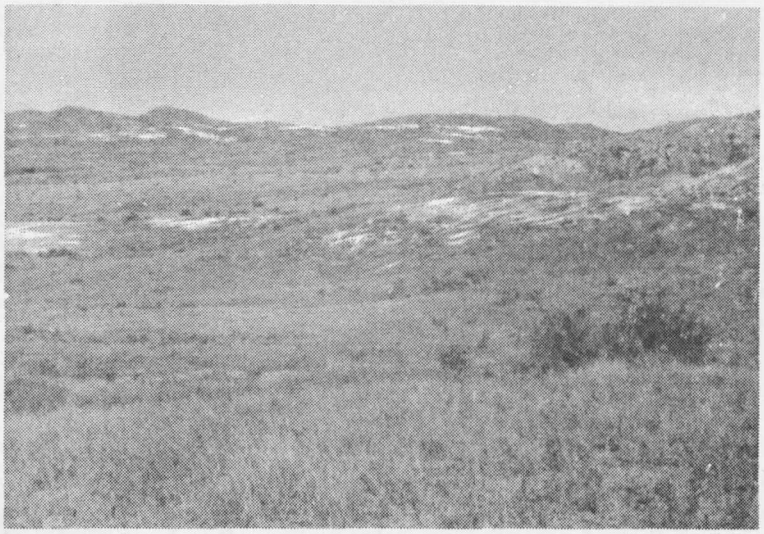

Figure 3. *Agropyron*-Leguminosae-*Gutierrezia* habitat type showing the numerous Solonchak spots on this type.

percent below, and 23.1 percent above the 10-year means, respectively. Average annual precipitation is around 13 inches. Summers are hot and dry and winters severe with long cold spells and infrequent blizzards.

METHODS

Habitat Analysis

Habitat types were distinguished to facilitate the studying of interspecific range-use relationships. Four of six habitat types recognized warranted analyses of vegetation and 82 stands were sampled by a method similar to that of Daubenmire (1959). A 2 x 5 decimeter plot was placed at 10-foot intervals along four, 50-foot lines, located in a relatively homogeneous and undisturbed portion of the stand. In each plot, percentage canopy coverage of each taxon and percentages of litter, rock, bare ground and lichen were visually estimated as follows: Class I = 0-5 percent; Class II = 5-25 percent; Class III = 25-50 percent; Class IV = 50-75 percent; Class V = 75-95 percent; and Class VI = 95-100 percent. The class mid-point was used for tabulation of data.

Within the *Artemisia-Agropyron* habitat type, sagebrush coverage categories were determined. At each stand in this type, sagebrush intercept was determined along a 100-foot line and is reported according to the following categories: rare = <1; scattered = 1-5; common = 6-20; and dense = >20 percent.

For the other two habitat types, a general reconnaissance allowed delineation and recognition of the existing plant communities.

Plant nomenclature followed Booth (1950) and Booth and Wright (1966).

Pronghorn-Livestock Distribution and Movements

A 111-mile vehicle route (Figure 1) was established to determine distributional patterns of the animals. This route was traversed at approximately 2-week intervals during early morning and evening periods when heat wave distortion was minimal. Observations were aided by the use of a 7 x 35 binocular and a 20X spotting scope.

Data recorded for pronghorns consisted of location to the nearest one-fourth mile, proximity to the nearest group of livestock within the same pasture to the nearest one-fourth mile, sex, age class (adult, fawn), group associations, habitat type and sagebrush aspect occupied and whether marked or unmarked. Twenty-one pronghorns were captured and individually marked prior to the initiation of field work in 1969; of these, newborn fawns were marked with ear streamers and the others with neck bands. In the spring of 1969, I captured 19 fawns and marked them with the following: expandable neck bands, plastic ear streamers and plastic hock streamers. For livestock (adults and yearlings only) pasture occupancy and duration were recorded.

Late spring, summer and early fall, 1969, home ranges were calculated by a method similar to the one described by Hayne (1949) for individuals observed five or more times after initial marking.

Pronghorn-Livestock Food Habits Analyses

Feeding site examinations provided the primary basis for determining food habits (Cole 1956, and others). Frequencies of use for each taxon were recorded. For grasses and grass-like plants, use of a rooted stem, for forbs, a single leaf or stem, and for shrubs, a leader, constituted one instance of use.

The aggregate volume method was used to determine usage by taxon for each month, whereas the aggregate percentage method was used for seasonal calculations, Martin *et al.* (1946).

Analysis of a rumen sample from each of two pronghorns collected each month plus any other obtainable rumen material from pronghorns or livestock supplemented and served as a basis to compare food habits determined by the feeding site method. Rumen analyses in general followed the techniques described by Norris (1943), Saunders (1955) and Cole (1956). Data from rumen analyses were tabulated in the same manner as those for feeding sites.

Chemical Analysis of Forage Plants

Samples of various forage plants were randomly collected over the entire study area at monthly intervals. Each sample consisted of that portion of the plant which was found to be consumed by livestock and/or pronghorns. The sample contained material from numerous sites. This partially obscured variations that might occur from differences in soil

and site condition.

Chemical analyses on air dry matter of protein, ether extract, crude fiber and ash followed the procedures of A. O. A. C. (1965) sections 22.011, 22.033, 22.042 and 22.010, respectively, and were carried out by personnel of the Chemistry Station Analytical Laboratory, Montana State University. A modified A. O. A. C. procedure (Chemistry Station Analytical Laboratory, MSU) was used for calcium and phosphorous analyses.

Physical Characteristics

Two pronghorns per month were removed from the study area from April to September, 1969. Sex, whole and hog-dressed weights, gross evidence of internal and external parasites, and certain standard measurements were recorded for each specimen. The year-class was determined by dentition, Dow and Wright (1962). Fat content of marrow, determined by the compression method, Greer (1968), and kidney fat indexes, Ransom (1965), aided determination of physical condition.

RESULTS-DISCUSSION

Habitat Types

The general distributional pattern of the six habitat types is shown in Figure 1. The results of quantitative analyses of the vegetation for four of these types are presented in Table 1.

AGROPYRON-ARTEMISIA HABITAT TYPE

This type (Figures 4 to 7) occurred throughout the study area and occupied approximately 79.1 percent of the study area. The dominant shrub, *Artemisia tridentata*, showed a wide variation of growth form which was apparently related to past grazing history, soils and topography. The sagebrush coverage (Figures 4 to 7) and its association with various forbs and grasses changed considerably within a relatively short distance at any given site. The environmental factors responsible were not determined, although association differences appeared to be at least in part related to the sagebrush coverage. Vegetational analysis data for the four categories of sagebrush coverage (Table 2) indicated fewer grass species in the dense category than in any other. Only five grasses (*Agropyron smithii*, *Koeleria cristata*, *Poa* spp., *Schedonnardus paniculatus*, and *Stipa viridula*) occurred on all four sagebrush aspects. Of these, *Agropyron smithii*, accounted for 80.4 percent of the combined canopy coverage for these five species. Numbers of shrub species were approximately the same from one category to the next but the canopy coverage and frequency increased from the rare to the dense aspect.

TABLE 1. VEGETATIONAL AND OTHER CHARACTERISTICS OF THE FOUR HABITAT TYPES SAMPLED BY ANALYSES OF 1,640, 2 X 5 DECIMETER PLOTS.

Taxa[1]	HABITAT TYPES			
	Agropyron-Artemisia	*Agropyron-*Leguminosae-*Gutierrezia*	*Agropyron-Melilotus-Stipa*	*Agropyron-Artemisia-Sarcobatus*
	47 Stands (940 Plots)	16 Stands (320 Plots)	11 Stands (220 Plots)	8 Stands (160 Plots)
GRASSES AND GRASS-LIKE PLANTS:				
Agropyron smithii	100/47/94[2]	100/35/86	91/51/89	87/33/79
Bouteloua gracilis	3/ 4/ 9	37/ 5/13	9/ +/ +	12/ +/ 2
Bromus japonicus	20/ 2/ 8	6/ 1/ 3	9/ 2/ 9	--
Buchloe dactyloides	3/ 6/13	19/ 9/12	18/ 3/ 6	25/ 2/ 5
Carex spp.	24/ 2/ 7	50/ 5/20	18/ +/ 1	--
Carex filifolia	13/ 4/ 9	6/ +/ 2	27/ 2/ 7	--
Distichlis stricta	14/ 1/ 4	37/ 2/13	--	12/ +/ 3
Hordeum jubatum	7/ +/ 1	6/ +/ +	9/ 4/ +	12/ +/ 2
Koeleria cristata	44/ 2/12	69/ 4/24	45/ 4/19	25/ +/ 2
Muhlenbergia cuspidata	11/ 1/ 3	44/ 6/17	--	--
Poa spp.	70/ 3/20	37/ +/ 3	64/ 5/26	62/ 3/16
Schedonnardus paniculatus	48/ 2/12	31/ +/ 3	46/ 3/13	62/ 1/ 7
Stipa comata	+/ 1/ 3	--	--	--
Stipa viridula	43/ 4/13	69/ 3/14	55/ 8/18	12/ +/ 1
Total Grasses	100/67/99	100/57/94	91/70/90	100/39/82
SHRUBS:				
Artemisia cana	9/ 1/ 3	--	--	--
Artemisia tridentata	83/10/33	31/ 1/ 6	--	87/13/51
Atriplex nuttallii	24/ +/ 3	37/ 1/ 3	9/ +/ 1	25/ 1/ 6
Chrysothamnus viscidiflorus	--	25/ 1/ 4	--	--
Gutierrezia sarothrae	36/ 1/10	56/ 3/16	--	25/ +/ 2
Sarcobatus vermiculatus	--	19/ +/ 2	--	87/ 3/17
Symphoricarpos occidentalis	8/ +/ +	--	9/ 1/ 2	--
Total Shrubs:	96/13/45	94/ 7/32	82/ 2/ 3	100/19/64

TABLE 1. (CONTINUED).

Taxa	HABITAT TYPES			
	Agropyron-Artemisia	*Agropyron-* Leguminosae-*Gutierrezia*	*Agropyron-Melilotus-Stipa*	*Agropyron-Artemisia-Sarcobatus*
	47 Stands (940 Plots)	16 Stands (320 Plots)	11 Stands (220 Plots)	8 Stands (160 Plots)
FORBS:				
Achillea millefolium	41/ 2/15	19/ +/ 2	34/ 1/ 9	50/ +/ 4
Allium textile	28/ 1/15	6/ +/ +	18/ +/ 1	12/ +/ 1
Artemisia frigida	49/ 2/11	56/ 3/23	9/ +/ 2	37/ 1/ 5
Artemisia longifolia	--	31/ 1/ 7	--	12/ +/ 2
Aster falcatus	24/ 1/ 9	56/ 1/10	--	25/ +/ 1
Astragalus bisulcatus	17/ +/ 2	37/ 1/ 7	--	12/ +/ 2
Astragalus cibarius	17/ +/ 3	25/ 1/ 5	18/ 1/ 2	12/ +/ 1
Atriplex dioeca	--	19/ 1/ 2	--	--
Comandra umbellata	20/ +/ 3	56/ 1/14	--	--
Eriogonum flavum	--	31/ +/ 3	--	12/ 1/ 7
Eriogonum multiceps	--	12/ 1/ 3	--	--
Haplopappus multicaulis	--	25/ +/ 2	9/ +/ +	37/ 1/ 7
Helianthus petiolaris	6/ +/ 1	6/ +/ 1	18/ 3/10	--
Iva axillaris	40/ 1/13	75/ 3/22	46/ 6/25	25/ +/ 5
Lomatium foeniculaceum	24/ 3/10	--	18/ 2/ 8	25/ +/ 1
Lomatium macrocarpum	34/ 2/12	6/ +/ 2	9/ +/ 1	--
Medicago sativa	--	--	9/ 4/ 8	--
Melilotus officinalis	9/ +/ 1	37/ 3/13	45/15/25	12/ +/ 2
Monolepis nuttalliana	--	6/ +/ 1	9/ 2/ 6	12/ +/ 1
Oxytropis campestris	--	25/ 2/11	--	--
Petalostemon candidum	7/ +/ 1	31/ 2/ 8	--	--
Petalostemon purpureus	10/ +/ 1	50/ 2/10	--	12/ +/ 2
Phlox hoodii	62/ 2/17	81/ 2/27	18/ +/ 1	37/ 1/ 6
Plagiobothrys scouleri	--	--	9/ 2/ 4	--
Plantago purshii	--	6/ +/ +	--	25/ 2/ 4
Polygala alba	--	19/ 1/ 4	--	--

TABLE 1. (CONTINUED).

Taxa	HABITAT TYPES			
	Agropyron-Artemisia	*Agropyron-* Leguminosae-*Gutierrezia*	*Agropyron-Melilotus-Stipa*	*Agropyron-Artemisia-Sarcobatus*
	47 Stands (940 Plots)	16 Stands (320 Plots)	11 Stands (220 Plots)	8 Stands (160 Plots)
Polygonum ramosissimum	16/ +/ 3	6/ +/ +	36/ 5/20	25/ +/ 3
Sedum lanceolatum	--	--	--	12/ 1/ 7
Sphaeralcea coccinea	70/ 2/17	50/ +/ 7	18/ 1/ 4	25/ +/ 2
Taraxacum officinale	18/ 2/ 7	25/ +/ 3	36/ 1/ 6	--
Tragopogon dubius	15/ +/ 2	25/ 1/ 7	18/ +/ 1	--
Vicia americana	71/ 2/23	75/ 2/17	45/ 3/13	25/ 1/ 6
Viola nuttallii	7/ +/ 2	--	9/ 2/ 5	12/ +/ 1
Unidentified Forbs	36/ 1/12	12/ +/ 3	36/ 1/15	25/ 1/12
Total Forbs	100/23/83	100/29/92	100/40/90	87/ 8/52
MISCELLANEOUS RANGE DATA:				
Cactus	58/ 2/ 9	12/ +/ 1	9/ 1/ 4	75/ 7/31
Bare Ground	100/26/89	100/29/97	100/23/92	100/43/100
Rock	76/ 4/33	94/17/93	9/ +/ 1	50/ 2/21
Lichen	61/ 2/21	25/ +/ 4	9/ 1/ 1	75/ 8/51
Litter I (standing)	100/40/99	100/28/96	100/58/91	100/22/93
Litter II (lying)	100/56/100	100/36/99	100/55/100	100/34/96

[1] Includes only those species having 1 percent or greater canopy coverage and 10 percent or greater frequency for at least one habitat type. Species with lesser values are: *Agropyron* spp.; *Festuca octoflora; Poa secunda; Rosa* spp.; *Arnica fulgens; Artemisia ludoviciana; Astragalus canadensis; Astragalus gilviflorus; Astragalus lotiflorus; Astragalus missouriensis; Astragalus spatulatus; Atriplex argentea; Bahia oppositifolia; Besseya wyomingensis; Chenopodium album; Chenopodium capitatum; Cirsium undulatum; Collomia linearis; Crepis runcinata; Cryptanthe bradburiana; Descurainia sophia; Echinaceae pallida; Epilobium paniculatum; Erysimum asperum; Euphorbia serphyllifolia; Gaura coccinea; Gilia congesta; Glycyrrhiza lepidota; Grindelia squarrosa;*

TABLE 1. (CONTINUED).

Haplopappus spinulosus; Kochia scoparia; Lactuca pulchella; Lappula redowskii; Lepidium densiflorum; Lesquerella alpina; Lesquerella ludoviciana; Leucocrinum montanum; Liatris punctata; Linum rigidum; Microseris cuspidata; Microsteris gracilis; Musineon divaricatum; Penstemon eriantherus; Plantago elongata; Polygonum spp.; *Psoralea argophylla; Ratibida columnifera; Rumex crispus; Taraxacum laevigatum; Thermopsis rhombifolia; Xanthium strumarium;* and *Zigadenus paniculatus.*

[2] __/__/__ Constancy = percent occurrence among stands/Canopy Coverage = percent areal coverage/Frequency = percent occurrence among plots; + = value of less than 1 percent.

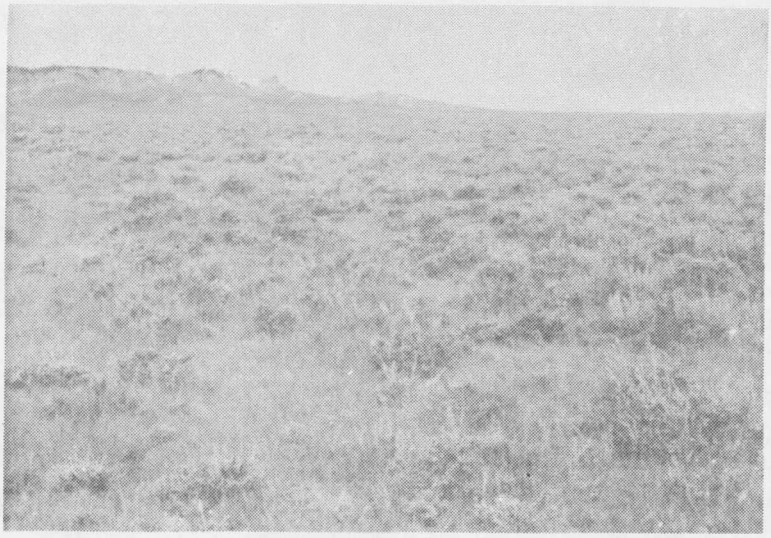

Figure 4. *Agropyron-Artemisia* habitat type; sagebrush aspect dense.

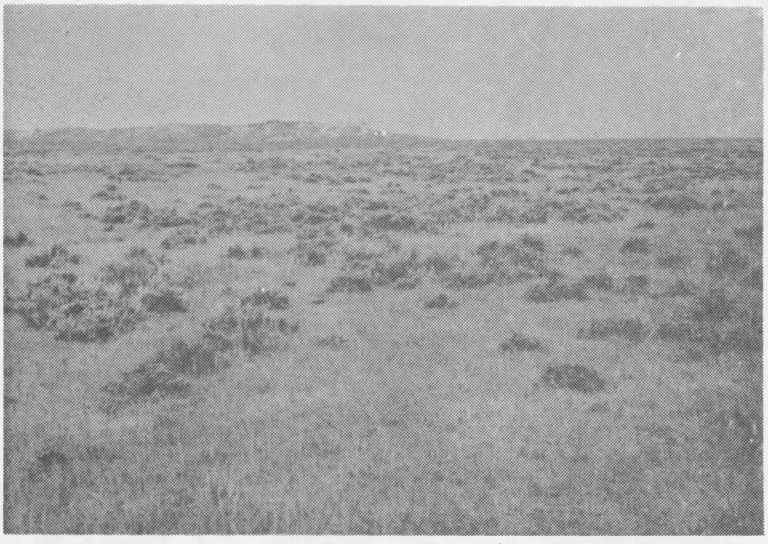

Figure 5. *Agropyron-Artemisia* habitat type; sagebrush aspect common.

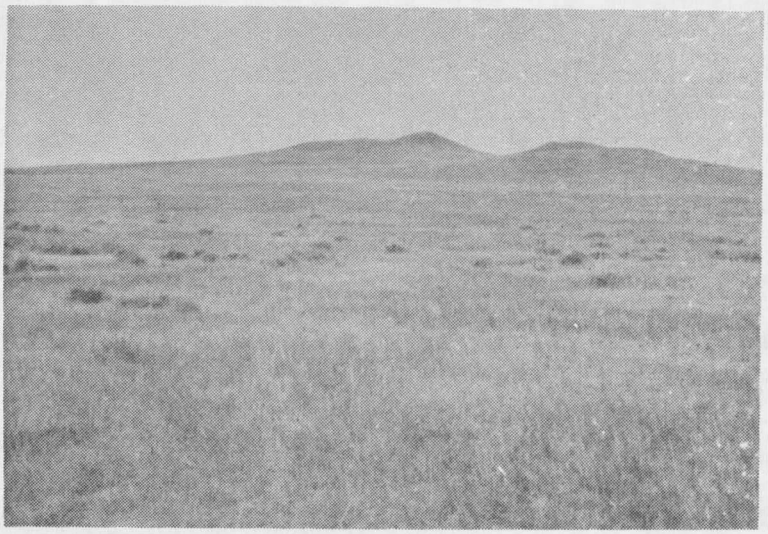

Figure 6. *Agropyron-Artemisia* habitat type; sagebrush aspect scattered.

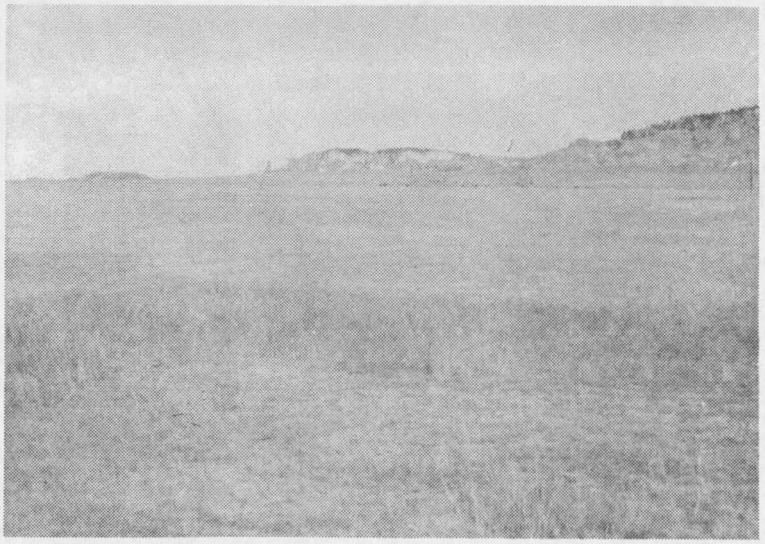

Figure 7. *Agropyron-Artemisia* habitat type; sagebrush aspect rare.

TABLE 2. VEGETATIONAL CHARACTERISTICS OF FOUR CATEGORIES OF SAGEBRUSH COVERAGE AND SHEEP PASTURES WITHIN THE *AGROPYRON-ARTEMISIA* HABITAT TYPE AS DETERMINED BY ANALYSES WITHIN 1,060, 2 X 5 DECIMETER PLOTS.

Forage Class	*AGROPYRON-ARTEMISIA* HABITAT TYPE — SAGEBRUSH ASPECT				
	Dense[1]	Common[1]	Scattered[1]	Rare[1]	Pastures With Past History of Sheep Use
	7 Stands (140 Plots)	16 Stands (320 Plots)	18 Stands (360 Plots)	6 Stands (120 Plots)	6 Stands (120 Plots)
GRASSES AND GRASS-LIKE PLANTS:					
Number Species	7	14	13	14	10
Canopy Coverage	67	67	64	70	71
Frequency	99	99	99	99	100
SHRUBS:					
Number Species	3	3	3	5	3
Canopy Coverage	22	14	8	6	17
Frequency	71	53	32	26	54
FORBS:					
Number Species	23	37	49	27	14
Canopy Coverage	24	20	25	21	13
Frequency	84	77	79	92	58

[1] Sagebrush Categories: Dense = >20; Common = 6-20; Scattered = 1-5; Rare = <1 percent line intercept.

Artemisia tridentata, *Atriplex nuttallii*, and *Gutierrezia sarothrae* each occurred on at least three of the four sagebrush aspects with the former accounting for 75.5 percent of total canopy coverage for shrubs. Approximately equal numbers of forb species occurred on the rare and dense sagebrush aspects, however a progressive increase in numbers of species was noted as coverage decreased from the dense to scattered aspect. Frequency and canopy coverage for total forbs remained about constant within the various aspects. The following forbs (*Achillea millefolium*, *Artemisia frigida*, *Aster falcatus*, *Iva axillaris*, *Lomatium foeniculaceum*, *L. macrocarpum*, *Phlox hoodii*, *Sphaeralcea coccinea*, *Taraxacum officinale* and *Vicia americana*) each occurred on at least three of the four sagebrush aspects and represented 76.5 percent of the total canopy coverage for forbs.

Vegetation of the sheep pastures differed from the other aspects mainly in the relative abundance of forbs. Lower values were recorded for number of species, canopy coverage and frequency. Seven of the ten major species listed for the *Agropyron-Artemisia* type occurred here. *Cirsium undulatum* with a value of 2 percent and *Plantago purshii* with 15 percent occurred with greater frequency on the sheep pastures. Maximum values for other aspects were 1 and 4 percent, respectively.

AGROPYRON-LEGUMINOSAE-GUTIERREZIA HABITAT TYPE

Approximately 9.4 percent of the area was occupied by this type (Figure 8), which occurred on areas of greatest relief, characterized by shale outcroppings, numerous Solonchak spots and impermeable soil. The dominant grass, *Agropyron smithii*, occurred throughout this type with stands of high density being associated with the drainages. Other characteristic grasses were *Buchloe dactyloides* and *Muhlenbergia cuspidata*. The dominant shrub was *Gutierrezia sarothrae*. *Artemisia tridentata* and *Atriplex nuttallii* were of approximately equal importance. Members of the Legume family were predominant among the characteristic forbs and were represented by a minimum of 16 species. *Melilotus officinalis* and *Petalostemon candidum* and *P. purpureus* were dominant among this group and occupied the more mesic sites. Other important forbs were *Artemisia frigida* and *Iva axillaris*.

AGROPYRON-MELILOTUS-STIPA HABITAT TYPE

This type (areal coverage 6.6 percent) which through succession is slowly reverting back to the *Agropyron-Artemisia* type, occurs on areas of past cultivation seeded primarily to *Agropyron smithii*. This type (Figure 9) is found primarily along major drainages or where spreader dikes tend to increase available moisture. *Agropyron smithii*, *Stipa viridula*, and *Poa* spp. are the dominant grasses. Characteristic forbs are *Melilotus officinalis*, *Iva axillaris*, and *Polygonum ramosis-*

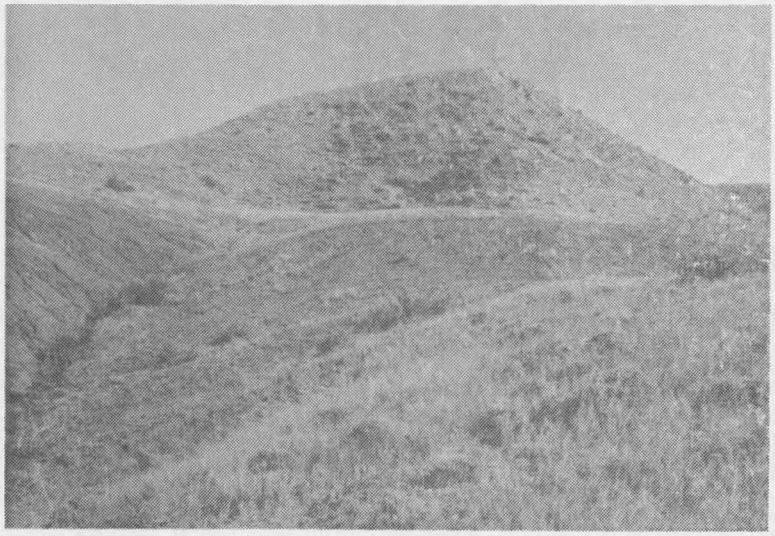

Figure 8. *Agropyron*-Leguminosae-*Gutierrezia* habitat type.

simum, each of which may achieve dominance on certain sites. Peripheral invasion by *Artemisia tridentata* and *Atriplex nuttallii* is widespread.

AGROPYRON-ARTEMISIA-SARCOBATUS HABITAT TYPE

This type (Figure 10) found primarily along drainages where heavy dense clay soils exist comprised 3.6 percent of the area. The dominant grass was *Agropyron smithii*. Characteristic shrubs were *Sarcobatus vermiculatus* and *Artemisia tridentata*. *Artemisia frigida*, *Phlox hoodii*, *Achillea millefolium* and *Haplopappus multicaulis* were the most frequently encountered forbs. The lowest total canopy coverage for grasses and forbs and the highest for shrubs and cactus were found on this type. Percentage of bare ground was also greatest on this type.

MISCELLANEOUS HABITAT TYPES

Two types, which comprised approximately 1.3 percent of the area, were *Pinus-Symphoricarpos* habitat type (Figure 11) and *Medicago-Avena-Hordeum* habitat type (Figure 12). The latter was found only in the north portion of the area where it occurred in small tracts of 100 acres or less. The alfalfa fields were located adjacent to Hackberry and Cottonwood Creeks. The grain fields were situated more distant and only in the area of Cottonwood drainage. The *Pinus-Symphoricarpos* type was confined to the west portion and was nearly inaccessible to pronghorns and

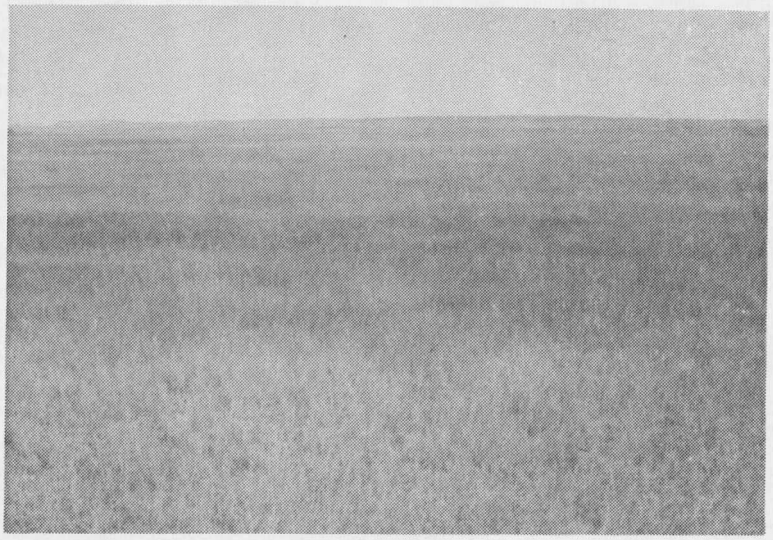

Figure 9. *Agropyron-Melilotus-Stipa* habitat type.

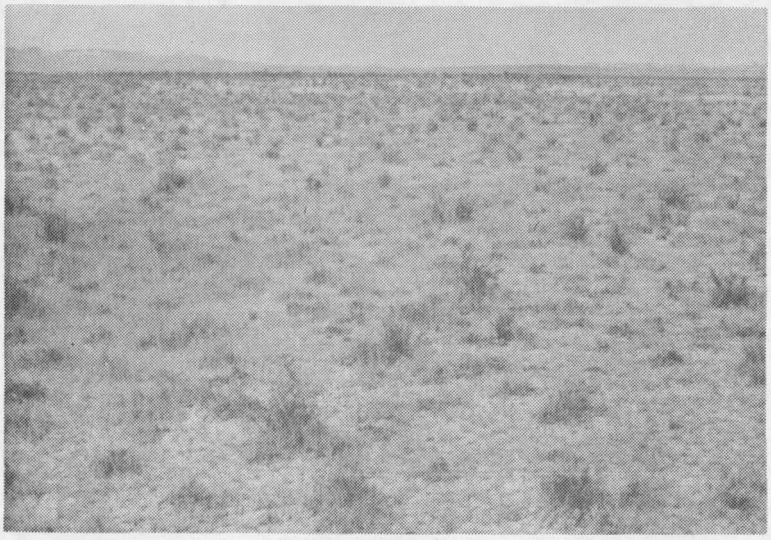

Figure 10. *Agropyron-Artemisia-Sarcobatus* habitat type.

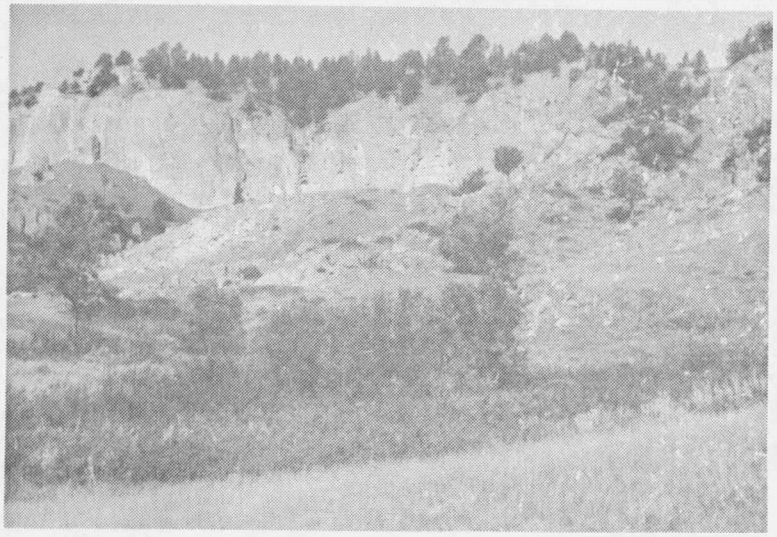

Figure 11. *Pinus-Symphoricarpos* habitat type.

Figure 12. *Medicago-Avena-Hordeum* habitat type.

livestock due to surrounding cliffs. Stands of *Pinus ponderosa* and thickets of *Symphoricarpos occidentalis* characterized this type.

Pronghorn Population Characteristics

From August to September, 1968 and April to September, 1969 a total of 5,000 individual pronghorn observations was classified as to age and sex while traveling the vehicle observation route (Table 3).

Pronghorn densities for summer and early fall of 1968 and late spring, summer and early fall of 1969 were 2.7, 3.0, 2.2, 2.6, and 2.9, respectively. These densities are higher than any previous densities recorded for this area since 1950 (Montana Fish and Game, Project Completion Reports, 1950, 1955, 1959 and 1965). The maximum number of fawns per 100 females, and the average number of fawns observed per season were somewhat less in 1969 than in 1968. Roberts (1970) noted a lowered fawn:female ratio following a year with a higher fawn:female ratio and related this to the relatively larger number of yearling females in the population the second year. However, his average number of fawns per period was about the same for both years. The lower number of fawns per 100 females in 1969 that I observed thus could be explained by the greater number of yearling females in the 1969 population as a result of a higher fawn:female ratio the previous year and to lower fawn production in 1969.

TABLE 3. SEX, AGE, FEMALES PER 100 MALES AND FAWNS PER 100 FEMALES FOR PRONGHORNS AS DETERMINED FROM OBSERVATION ROUTE COUNTS.

Date[1]	ADULTS Number M*	Percent	Number F*	Percent	Number Fawns	Percent	Total Classified	Fawns: 100 Females	Females: 100 Males
SPRING:									
4/23/69	108[2]	33.8[3]	212	66.2	--	--	320	--	196
5/9/69	147	40.2	219	59.8	--	--	366	--	149
5/26/69	106	34.4	186	60.4	16	5.2	308	8.6	176
Total or Average	361	36.3	617	62.1	16	1.6	994	2.9	174
SUMMER:									
6/11/69	104	34.8	170	56.8	25	8.4	299	14.7	164
6/24/69	116	24.8	224	48.0	127	27.2	467	56.7	193
7/13/69	86	26.5	135	41.5	104	32.0	325	77.0	157
7/29/69	107	26.6	174	43.3	121	30.1	402	69.5	163
8/12/69	115	28.3	168	41.3	124	30.4	407	73.8	146
8/27/69	112	27.8	173	42.9	118	29.3	403	68.2	155
Total or Average	640	27.8	1,044	45.3	619	26.9	2,303	60.0	163
FALL:									
9/14/69	140	31.8	182	41.3	119	26.9	441	65.4	130
Total or Average	140	31.8	182	41.3	119	26.9	441	65.4	130
TOTAL -- 1969:	1,141	30.5	1,843	49.3	754	20.2	3,738	42.8	156

TABLE 3. (CONTINUED).

Date	ADULTS Number M	Percent	Number F	Percent	Fawns	Percent	Total Classified	Fawns: 100 Females	Females: 100 Males
SUMMER:									
8/2/68	90	19.9	189	41.7	174	38.4	453	92.1	210
8/27/68	91	25.5	149	41.7	117	32.8	357	78.5	164
Total or Average	181	22.7	338	41.7	291	35.6	810	85.3	187
FALL:									
9/12/68	105	23.2	169	37.4	178	39.4	452	105.3	161
Total or Average	105	23.2	169	37.4	178	39.4	452	105.3	161
TOTAL -- 1968	286	22.7	507	40.2	469	37.5	1,262	95.3	174

[1] = Date the route was started -- usually 3 days were required for completion.
[2] = Number of individual observations for each period in each category.
[3] = Percent of the total classified for each period in each category.
* M = Males; F = Females.

The average summer population composition for both years combined was 26.6 percent males, 44.7 percent females and 28.7 percent fawns. Martinka (1966) reported on the summer population composition for an area in northeastern Montana for a 6-year period and indicated lower proportions of females and males but a greater proportion of fawns.

Group Sizes of Pronghorns

Changes in seasonal average group size (Table 4) reflected pronghorn behavior with respect to weather and certain stages of their life history. The largest group size was recorded in April of 1969. The smallest coincided with the pre-fawning and fawning periods of late May and early June when pregnant does moved away from previous associates for parturition. Buechner (1950) reported that a pregnant doe parted company with a buck 1 day before giving birth. The increasing average group size following the fawning period indicated that does with fawns soon join other female-fawn groups. Summer group size was intermediate between that for late spring and the fawning period. Average group size for September showed an increase over the summer period possibly reflecting changing condition of vegetation and/or near cessation of breeding activities. Buechner (1950) pointed out that following the breeding season, pronghorns formed large bands. Group size data collected by Bayless (1967) show the same seasonal fluctuations.

TABLE 4. TOTAL NUMBER OF OBSERVATIONS (SINGLES AND GROUPS), NUMBER OF PRONGHORNS OBSERVED AND AVERAGE GROUP SIZE ACCORDING TO SEASON.

Date of Route	Total Number Observations	Percent Singles	Percent Groups	Number Pronghorns Observed	Average Group Size (Singles Excluded)
LATE SPRING:					
4/23/69	39	12.8	87.2	336	9.74 (2-28)
5/9/69	62	16.1	83.9	366	6.85 (2-23)
5/26/69	87	36.8	63.2	308	5.02 (2-19)
Total or Average	188	21.9	78.1	1,010	7.20 (2-23)
SUMMER:					
6/11/69	96	37.5	62.5	299	4.38 (2-20)
6/24/69	81	17.3	82.7	467	6.76 (2-30)
7/13/69	61	9.8	90.2	325	5.80 (2-24)
7/29/69	72	25.0	75.0	402	7.11 (2-36)
8/12/69	66	18.2	81.8	407	7.31 (2-27)
8/27/69	63	17.5	82.5	403	7.54 (2-35)
Total or Average	439	20.9	79.1	2,303	6.48 (2-29)
EARLY FALL:					
9/14/69	71	22.5	77.5	441	7.73 (2-27)
Total or Average	71	22.5	77.5	441	7.73 (2-27)

Group observations on the four habitat types for all three seasons in 1969 totaled 484 (Table 5). The group size for late spring was largest on the *Agropyron-Artemisia* habitat type, and smallest on the *Agropyron-Artemisia-Sarcobatus* type. For summer, the smallest average group size was recorded for the *Agropyron-Artemisia-Sarcobatus* type and the largest for the *Agropyron*-Leguminosae-*Gutierrezia* type. The largest average group size for fall was recorded on the *Agropyron-Melilotus-Stipa* type and the smallest on the *Agropyron-Artemisia* type. Average group size increased on the *Agropyron*-Leguminosae-*Gutierrezia* type and the *Agropyron-Melilotus-Stipa* type but decreased on the *Agropyron-Artemisia* type as the seasons progressed.

TABLE 5. AVERAGE GROUP SIZE BY HABITAT TYPE AND SEASON.

	SEASON			
Habitat Type	Late Spring Average Group Size	Summer Average Group Size	Early Fall Average Group Size	All Seasons Group Size
Agropyron-Artemisia	7.4	6.4	6.3	6.7
Agropyron-Artemisia-Sarcobatus	3.0	5.6	10.0	8.9
Agropyron-Leguminosae-*Gutierrezia*	4.5	8.0	8.0	6.8
Agropyron-Melilotus-Stipa	4.9	7.0	12.4	8.1

Pronghorn Physical Characteristics

Biological material and various physical measurements were obtained from each of the 12 pronghorns collected from April to September, 1969 (Tables 6 and 7).

Average weights of males tended to increase with increasing age at least up to age four; however, total length appeared to level off after the second year. Horn length continued to increase up to and beyond age four. Considerable variation in average horn length was found among animals of a single age class and this variation was noted in all age classes. The physical measurements recorded were similar to those recorded by Buck (1947) and any differences could probably be attributed to the small sample size that I had and/or differences in dates of collection. Mason (1952) reported similar live weights and horn lengths for Hart Mountain pronghorns in Oregon.

A general examination for external and internal parasites on all 12 specimens collected indicated that these animals are almost entirely free from external parasites and that internal parasites are few. Roundworms of the genus *Haemonchus* were the only internal parasites detected and these were found in the abomasums of two males -- one 2-year-old and one 4-year-old.

From April to September kidney fat indexes tended to increase (Table 7) indicating an improvement in general body condition from spring to fall with the main increase occurring about the time that

TABLE 6. PHYSICAL MEASUREMENTS OF 12 PRONGHORNS COLLECTED FROM APRIL-SEPTEMBER, 1969.

Date of Collection	Sex	Age[1]	Weight[2]	T. L.[3]	Foot[4]	Tail[5]	C. Depth[6]	Horn L.[7]	Horn C.[8]
4/25/69	Female	3	92	50.5	14.2	5.5	13.5	--	--
4/21/69	Male	1	88	55.2	16.5	5.8	15.5	10.2	4.9
5/20/69	Male	1	74	52.0	15.2	5.8	13.8	6.4	5.0
9/16/69	Male	1	100	56.8	16.0	5.0	14.2	12.8	5.2
6/14/69	Male	2	105	58.9	17.2	5.5	14.2	11.6	5.4
7/14/69	Male	2	109	55.9	16.0	4.1	14.0	9.5	5.9
7/29/69	Male	2	116	58.1	16.2	4.8	15.0	11.8	5.2
5/22/69	Male	3	112	57.5	16.8	5.2	15.5	10.8	5.8
8/29/69	Male	3	124	59.4	16.4	6.0	15.0	11.9	5.2
6/14/69	Male	4	104	59.6	15.5	4.8	13.5	8.9	5.6
8/13/69	Male	4	134	59.4	16.2	5.4	16.8	15.1	7.0
9/10/69	Male	6	126	55.6	16.5	5.2	15.0	14.8	6.9

[1] = Determined by dentition, Dow and Wright (1962).
[2] = Weight to the nearest pound taken immediately after the animal was collected.
[3] = Total length to the nearest tenth of an inch.
[4] = Length of right rear foot to the nearest tenth of an inch.
[5] = Tail length to the nearest tenth of an inch.
[6] = Chest depth to the nearest tenth of an inch.
[7] = Average outside length of horns, from base to tip, to the nearest tenth of an inch.
[8] = Average basal circumference of horns to the nearest tenth of an inch.

TABLE 7. SUMMARY OF PRONGHORN BODY CONDITION DATA FOR 12 PRONGHORNS COLLECTED AT THE RATE OF TWO PER MONTH FOR THE PERIOD APRIL-SEPTEMBER, 1969.

Date of Collection	Assigned Age[1]	Sex	Kidney Fat Index[2]	Whole Weight	Hog Dressed Weight[3]	Dressing Percentage[4]	Percent Femur Marrow Compression[5]
4/21/69	1	Male	0.093	88	66	71.2	--
4/25/69	3	Female	0.110	92	58	63.0	--
5/20/69	1	Male	0.111	74	56	75.7	21
5/22/69	3	Male	0.265	112	80	71.4	10
6/14/69	4	Male	0.579	104	82	78.9	1
6/14/69	2	Male	0.134	105	76	72.4	3
7/14/69	2	Male	0.267	109	81	74.3	1.5
7/29/69	2	Male	0.438	116	84	72.4	<1.0
8/13/69	4	Male	1.023	134	97	72.4	<1.0
8/29/69	3	Male	0.762	124	94	75.8	<1.0
9/10/69	6	Male	0.462	126	88	69.8	<1.0
9/16/69	1	Male	0.667	100	71	71.0	<1.0

[1] = Determined by dentition, Dow and Wright (1962).
[2] = Calculated by dividing the wieght of the kidney with fat and capsule removed into the weight of the kidney fat and capsule.
[3] = Head and feet intact but visera and external genitalia of males removed.
[4] = Calculated by dividing hog dressed weight by whole weight.
[5] = Determined by a method similar to that of Greer (1968).

shrub use declined and where forbs became the major items in the diet. Percent femur marrow compression genererally decreased from May to August. The low values for August and September indicating high fat content were from pronghorns with kidney fat indexes above 30 percent (Ransom 1965).

The ratio of hog-dressed to whole weights (Table 7) remained quite consistent and with the exception of a pregnant female collected April 25, averaged 73.2 percent.

Pronghorn Movements -- Fence Type Relationships

Fences were classified in relation to pronghorns as passable (4 or less strands of barbed wire), moderately passable (5 strands of barbed wire), or impassable (6 strands of barbed wire or woven wire topped with 2 or more strands of barbed wire). The seasonal pasture shifts in relationship to fence types for pronghorns shown in Figures 13 to 15 indicate that the types of fences present had little overall influence on movement or distribution (e.g., pastures A, B, C, and D, Figures 13 to 15). I do not mean to infer that pronghorn movements cannot be influenced by fences, as I have witnessed incidences where the immediate destination of pronghorns has been unattainable due to fence type and/or their behavior towards fences in general. The majority of fences on the area were in a sagging condition. This, plus the presence of more than one type along one section of a pasture,

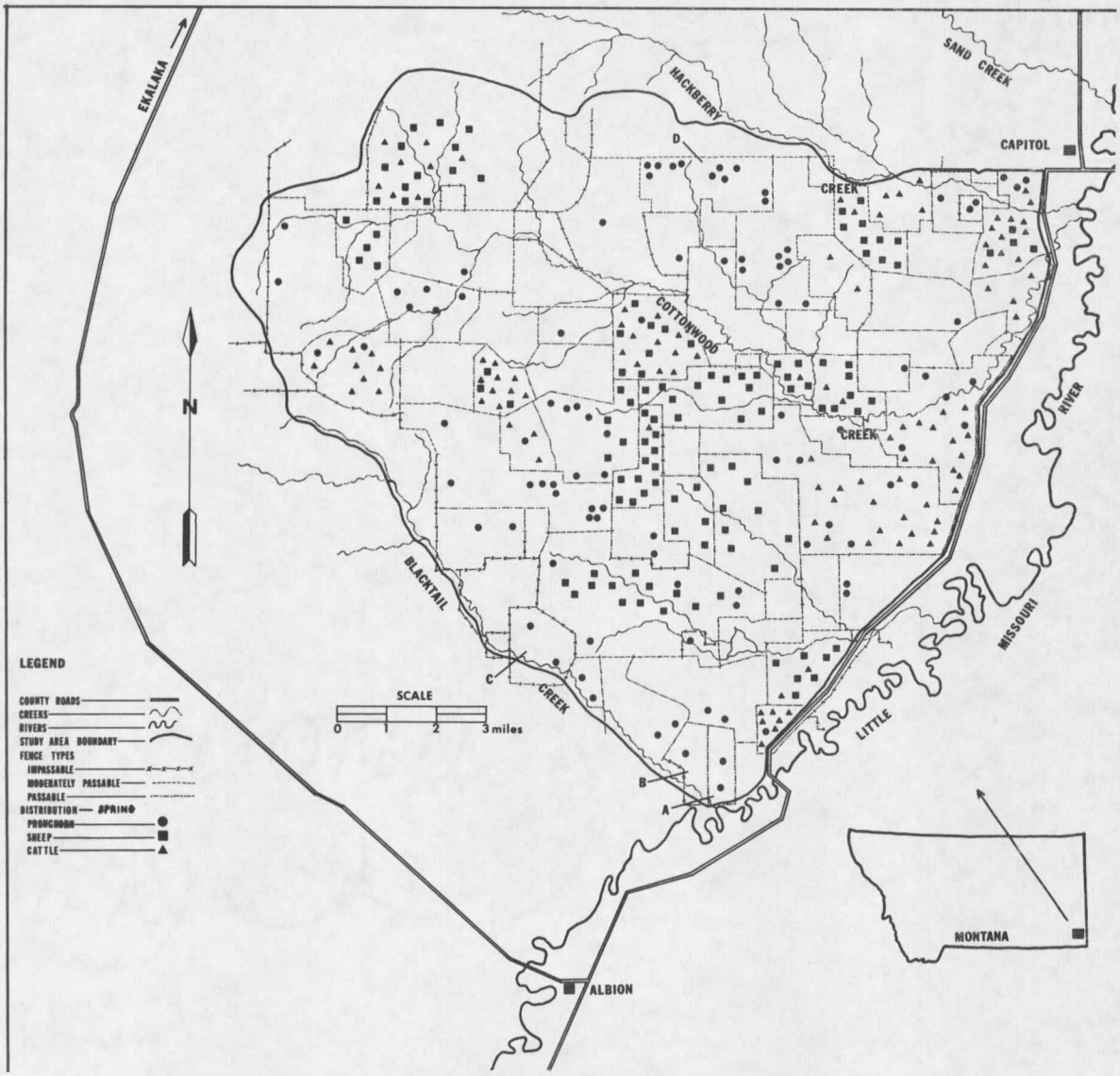

Figure 13. Study area showing fence types and *spring* pronghorn-livestock distribution. Each symbol indicating distribution depicts 1 percent of the total observations for that species.

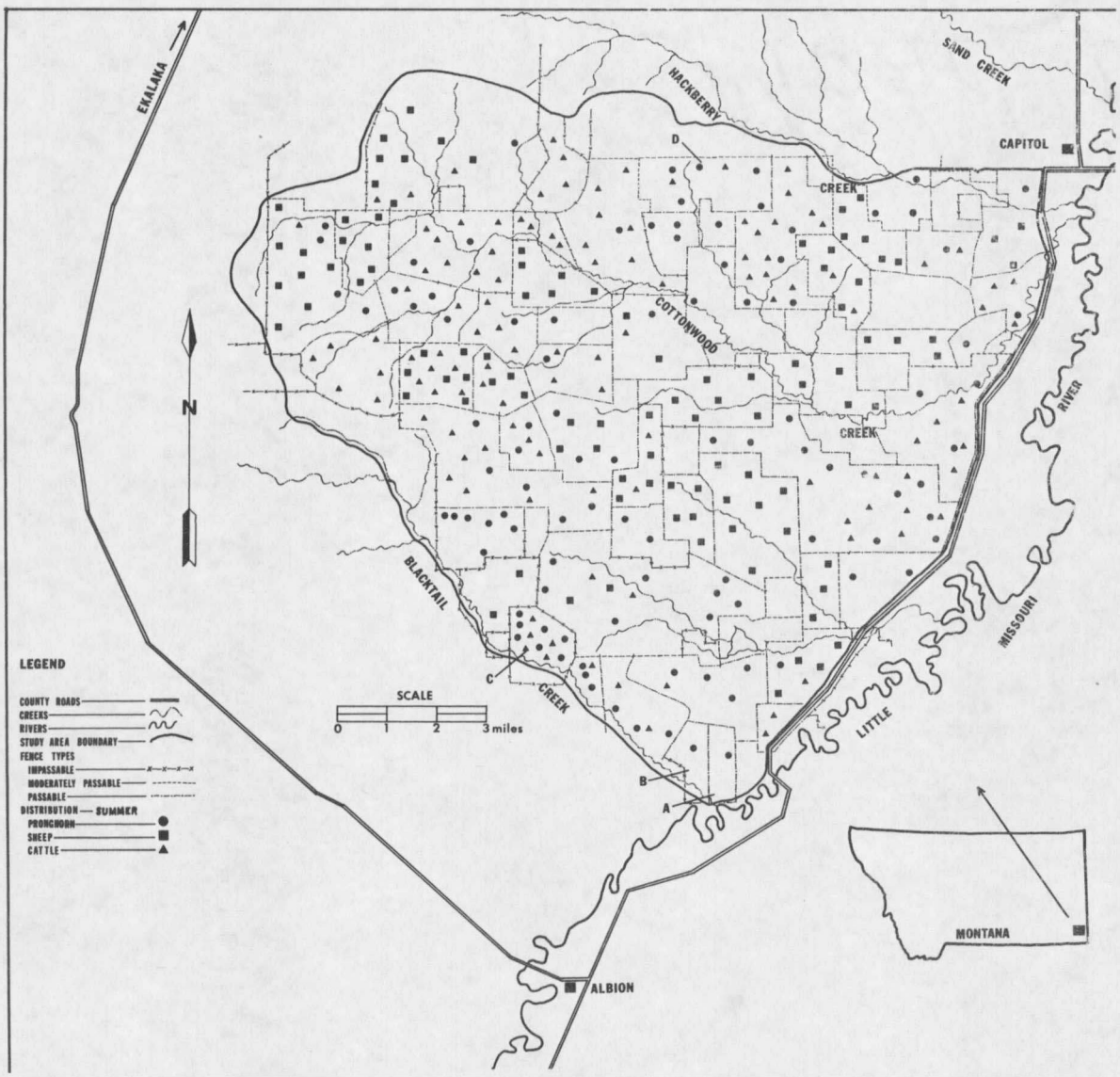

Figure 14. Study area showing fence types and *summer* pronghorn-livestock distribution. Each symbol indicating distribution depicts 1 percent of the total observations for that species.

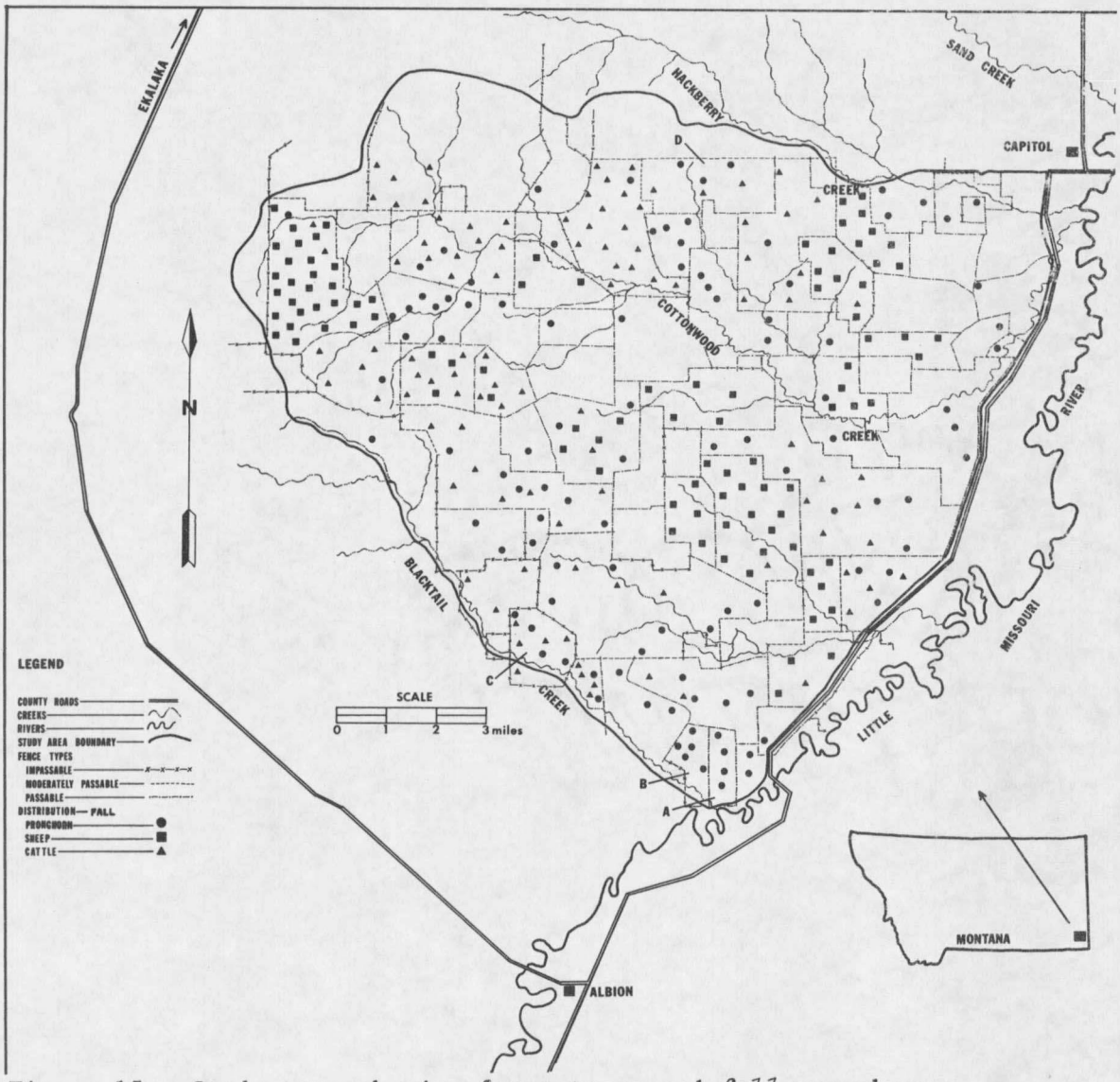

Figure 15. Study area showing fence types and *fall* pronghorn-livestock distribution. Each symbol indicating distribution depicts 1 percent of the total observations for that species.

and open gates between pastures may have been responsible for the lack of fence influence on pronghorn distribution. Sunderstrom (1966) pointed out that pronghorns may go through or under fences and will jump if the height of the fence is not over 32 inches. Milek (1966) drew from data compiled for pronghorns in Wyoming and indicated for one area over a 6-year period that a 57 percent decline in the population had occurred concurrently with extensive cross fencing of the area with sheep-tight fences. In general, other studies which reported on fence types and their effects on pronghorns have been conducted under artifical conditions or were of the rancher-interview type.

Pronghorn Home Ranges

Home range sizes for "bachelor" male groups, territorial males and female-fawn or female-fawn-male groups were determined from 195 observations of 16 individually recognizable pronghorns observed a minimum of five times each (Table 8).

Territorial males had a mean home range size 70 percent smaller than "bachelor" male groups; that for female-fawn or female-fawn-male groups was 30 percent smaller.

A standard analysis of variance, one-way classification, was performed to test the hypothesis that mean home range size for the three categories did not differ significantly. The test was run at the 5 percent level of significance with total degrees of freedom being 16.

TABLE 8. CALCULATED HOME RANGES AND OTHER MOVEMENT DATA FOR 16 INDIVIDUALLY RECOGNIZABLE PRONGHORNS FOR THE PERIOD APRIL-SEPTEMBER, 1969.

Sex -- Age	No. Obs.	Average Number Days Between Obs.	DISTANCE (MILES) Distance Between Home Ranges Seasons[1]	Years[2]	From Center of Range[3] (Mean)	(Max.)	Maximum Between Succ. Obs.	First To Last Obs.	Calculated Home Range Square Miles
Female-Adult (4)	15	10	--	--	1.2	2.5	4.2	1.1	5.39
Female-Adult (5)	13	8	--	--	1.4	2.5	2.7	2.5	7.70
Female-Adult (5)	19	5	--	--	0.4	0.9	1.1	0.5	0.83
Female-Yrlg.[4] (1)	11	6	4.4	--	0.6	1.0	2.0	1.5	0.85
Female-Fawn[4] (0)	5	26	--	1.5	0.9	1.3	2.5	1.0	1.78
Female-Fawn (0)	7	12	--	--	0.7	1.9	1.8	2.1	1.89
Female-Fawn (0)	13	7	--	--	0.4	0.9	1.1	1.1	0.73
Female-Fawn (0)	8	6	--	--	0.3	0.6	1.1	0.5	0.39
Female-Fawn (0)	9	15	--	--	0.4	1.3	2.2	0.4	0.61
Male-Fawn (0)	8	14	--	--	0.6	1.2	1.4	2.2	1.53
Male-Fawn (0)	13	7	--	--	1.0	2.5	2.1	0.7	2.23
Average Group I[5]	11	10.5	--	--	0.7	1.5	2.0	1.2	2.18
Male-Adult (5)	13	10	--	--	0.4	0.7	0.8	0.5	0.63
Male-Adult (4)	14	9	--	--	0.5	1.3	2.1	0.7	1.25
Average Group II[6]	13.5	9.5	--	--	0.45	1.0	1.45	0.6	0.94
Male-Adult (2)	13	12	--	--	0.8	2.5	3.8	1.6	4.55
Male-Adult (2)	10	15	--	--	0.6	1.5	1.8	1.6	1.88
Male-Yrlg. (1)	12	14	--	--	1.1	2.1	3.2	2.2	2.95
Male-Yrlg. (1)	12	11	--	--	0.9	1.5	1.4	2.0	3.14
Average Group III[7]	11.8	13.0	--	--	0.9	1.9	2.6	1.9	3.13

[1] = Geometric center to geometric center between seasons.
[2] = Geometric center to geometric center between years.
[3] = Geometric center of Hayne, 1949. [4] = Same animal.
[5] = Female-fawn or female-fawn-male groups. [6] = Territorial males.
[7] = "Bachelor" male groups.

The resulting F value of .88 warranted acceptance of the hypothesis with the following reservations: Other factors such as group size and related habitat requirements, livestock range use, and/or human activity which were not taken into account in the test may have been responsible for having to accept the hypothesis. Actual differences in home range sizes for the three categories may have existed, yet variations in individual home range size resulting from the aforementioned factors may have concealed any statistical difference.

Habitat Use and Distribution

PRONGHORNS

Distribution of pronghorns by season on the habitat types is shown in Table 9. A Chi-square goodness of fit test was conducted to test the hypothesis that the distribution of individual pronghorn observations and pronghorn groups was independent of habitat type. Both categories were tested separately and for all three seasons at the 5 percent level of significance with 4 degrees of freedom. The resulting Chi-square values (Table 9) required that the hypothesis be rejected. The much larger values for individual categories, as compared to the group categories for all three seasons, suggest that group classification may have more meaning concerning habitat use than individual classification.

Numbers of individual pronghorns using the *Agropyron-Artemisia* habitat type in late spring were greater than expected, while group

TABLE 9. ACTUAL AND "EXPECTED" DISTRIBUTION OF INDIVIDUALS AND GROUPS OF PRONGHORNS BY SEASON ON THE VARIOUS HABITAT TYPES.

Habitat Type and Percent Areal Occupancy	LATE SPRING				SUMMER				EARLY FALL			
	Number Pronghorns		Number Groups		Number Pronghorns		Number Groups		Number Pronghorns		Number Groups	
	Obs.[1]/ Percent[2]	Expected[3]	Obs.[4]/ Percent[5]	Expected	Obs./ Percent	Expected	Obs./ Percent	Expected	Obs./ Percent	Expected	Obs./ Percent	Expected
Agropyron-Artemisia Habitat Type = 79.1	880/86.9	798	145/80.5	142	1,687/73.1	1,821	204/76.4	211	225/57.8	349	88/67.7	102
Agropyron-Artemisia-Sarcobatus Habitat Type = 3.6	8/ 0.8	37	11/ 6.1	7	66/ 2.9	84	20/ 7.5	10	36/ 8.2	16	4/ 3.1	5
Agropyron-Leguminosae-*Gutierrezia* Habitat Type = 9.4	26/ 2.7	95	1/ 0.6	17	269/11.5	215	16/ 6.0	25	62/14.0	41	23/17.7	12
Agropyron-Melilotus-Stipa Habitat Type = 6.6	96/ 9.5	67	23/12.8	12	280/12.7	153	26/ 9.7	18	88/20.0	29	15/11.5	9
Medicago-Avena-Hordeum and *Pinus-Symphoricarpos* Habitat Types = 1.3	0/ 0.0	13	0/ 0.0	2	1/ 0.0	30	1/ 0.4	3	0/ 0.0	6	0/ 0.0	2
TOTAL = 100.0	1,010/100.0	1,010	180/100.0	180	2,303/100.0	2,303	267/100.0	267	441/100.0	441	130/100.0	130
Chi-square Values	106.8		19.41		160.8		18.33		205.9		18.20	

[1] = Individual pronghorn observations.
[2] = Percent of total individual pronghorn observations.
[3] = Expected individual or group observations determined by multiplying percent areal occupancy of a type times the total number of individual or group observations recorded for each season.
[4] = Groups of pronghorns observed.
[5] = Percent of all groups observed.

usage was approximately as expected. A decline in use, below the expected for summer and fall, occurred for both categories as the growing season progressed, with the group category reflecting the least change. This same trend in individual use in summer and early fall was noted by Wentland (1968) and Roberts (1970) for a similar habitat type. Wentland related this to seasonal desiccation of vegetation.

Group usage of the *Agropyron-Artemisia-Sarcobatus* habitat type in spring and summer was above the expected while individual usage was below. The reverse was true for early fall. The vegetation on this type, except for that in draws, became desiccated before that on any other type, probably due to soil type and the flat exposed nature of the topography. Thus, the below expected group usage during early fall tends to add significance to group classification as a means of measuring habitat preference (i.e., if pronghorn distribution is truly affected by desiccation of vegetation).

Occurrence of individuals on the *Agropyron*-Leguminosae-*Gutierrezia* habitat type showed a steady increase from spring to fall. Wentland (1968) noted the same trend for a similar type and related it to persistence of succulence of vegetation for the type. Individual usage was greater than expected for all three seasons but group usage was less than expected for all but the early fall period. The increased usage trend for both categories may be a reflection of abundance of succulent vegetation and livestock distribution. Plant development was somewhat

delayed on many sites in this type due to protection from the sun and wind provided by hills and buttes and to persistent snow accumulations. Qualitative observations indicated more draws per surface area in these hills than on the surrounding plains, hence more succulent vegetation during late summer and fall. Livestock usage occurred mainly toward the end of summer and was quite light in comparison to the other areas, Figures 13 to 15 and Figure 1.

Late spring, summer and early fall use of the *Agropyron-Melilotus-Stipa* type for individuals showed a steady seasonal increase, and was above the expected for all seasons. Group usage was twice the expected for spring. The decrease that occurred in summer corresponded with the cutting of wild hay and reflected the effects of seasonal human activity on pronghorn distribution. A major portion of this type was cut for wild hay in 1969. Group usage in early fall was again approximately twice the expected, and coincided with the cessation of haying activities. This group usage trend again lends support to group classification. The greater than expected group use for all seasons may have been related to the absence of livestock, which were excluded for the purpose of allowing the vegetation to be utilized as wild hay (compare location of this type, Figure 1, with livestock distribution, Figures 13 to 15).

Below-expected use of the *Medicago-Avena-Hordeum* habitat type and the *Pinus-Symphoricarpos* habitat type during all three seasons was

probably related to inaccessibility due to terrain or fence type, human activity and/or observational deficiencies.

On the *Agropyron-Artemisia* habitat type, sagebrush aspect category was recorded for 2,822 individual pronghorns observations in 1969, Table 10. The common aspect which showed a progressive seasonal increase in use also received the greatest use all three seasons. Summer and fall use of the dense category was about double that for spring. When use data for the three seasons were grouped it was found that 88 percent of all individual observations on the *Agropyron-Artemisia* type were on the common to scattered aspects. This is not necessarily indicative of a preference for these categories as areal coverage of each aspect was not determined.

There were two primary areas of late spring pronghorn concentration. One was between the mid-sections of Hackberry and Cottonwood Creeks and the other was approximately 2 miles north of the mid-section of Blacktail Creek. These late concentrations were probably the result of the severe and prolonged 1968-69 winter. Buck (1947) and others have noted that pronghorns congregate in bands during winter and disperse in spring. Both of the concentrations were in areas where hills and buttes (*Agropryon*-Leguminosae-*Gutierrezia* habitat type) joined sagebrush plains (*Agropyron-Artemisia* type) which suggested the use of the hills for protection from storms. Small groups occurred over most of the remaining

TABLE 10. DISTRIBUTION BY MONTH OF 2,822 INDIVIDUAL PRONGHORN OBSERVATIONS IN RELATION TO SAGEBRUSH COVERAGE FOR THE *AGROPYRON-ARTEMISIA* HABITAT TYPE.

Month	SAGEBRUSH COVERAGE CATEGORIES				Total Number of Individual Pronghorn Observations
	Dense	Common	Scattered	Rare	
LATE SPRING:					
April	12[1]/4.0[2]	190/63.6	82/27.4	15/ 5.0	299/100
May	27/4.7	308/53.0	167/28.7	79/13.6	581/100
Season Average	39/4.4	498/56.6	249/28.3	94/10.7	880/100
SUMMER:					
June	42/7.5	369/65.7	139/24.7	12/ 2.1	562/100
July	45/8.2	326/59.1	152/27.5	29/ 5.3	552/100
August	48/8.4	363/63.4	150/26.2	12/ 2.1	573/100
Season Average	135/8.0	1,058/62.7	441/26.1	53/ 3.1	1,687/100
EARLY FALL:					
September	20/7.8	183/71.8	52/ 2.0	0/ 0.0	255/100
Season Average	20/7.8	183/71.8	52/ 2.0	0/ 0.0	255/100
ALL SEASON AVERAGE	194/6.9	1,739/61.6	742/26.3	147/5.2	2,822/100

[1] = Number of individual pronghorn observations.
[2] = Percent of total individual pronghorn observations.

area. Summer pronghorn distribution was somewhat uniform except in certain areas occupied by sheep where pronghorns were absent. Early fall distribution was again somewhat uniform with a few areas of concentration becoming noticeable.

Dirschl (1963) stated that seasonal pronghorn distribution was correlated with distribution of food supply. The preceding discussion of pronghorn habitat use and distribution is in general agreement with this statement. I believe that other factors, such as group usage rather than just individual use, human activity, past grazing history of the area, livestock distribution (especially of sheep), and availability of different parts of an area must all be included in considerations in order to achieve a satisfactory understanding of pronghorn distribution.

LIVESTOCK

Cattle and sheep distribution was governed by the rancher and fences. Concentrations in late spring were primarily along the mid-section of Cottonwood Creek and on both sides of the road that paralleled the Little Missouri River. By early summer cattle were distributed fairly evenly over most of the area except in the hills and buttes (*Agropyron*-Lugumi-nosae-*Gutierrezia* habitat type). By mid-summer some livestock, mainly cattle, were moved into this previously unoccupied area. Summer sheep distribution was not as uniform as that for cattle. Cattle occupied 44

percent of all pastures during the summer and sheep occurred in only 30 percent. Fall cattle and sheep distribution was similar to summer, except for some movement back toward spring and winter concentration points. Livestock preferences for habitat types could not be determined as fences restricted their movements and resulted in non-availability of certain types. In general, most livestock use for late spring, summer and early fall was on the *Agropyron-Artemisia* type, due primarily to its widespread occurrence. Figures 13 to 15 and comparisons with Figure 1 generally show the above mentioned trends, even though observational data were combined seasonally which tended to obscure some intraseasonal changes.

Pronghorn-Livestock Pasture Use and Association

A seasonal pattern of pronghorn distribution among pastures was discernible in relationship to livestock use (Figure 16 and Table 11). In the late spring, approximately 66 percent of all pastures were devoid of livestock and 66 percent of all pronghorns were observed in pastures not occupied by livestock; however only 36 percent of the pastures not occupied by livestock were utilized by pronghorns. This same general trend in percent use of pastures not occupied by livestock was noted for all three seasons. Factors other than non-occupancy by livestock, such as pasture size, human activity, past grazing history, and vegetation acting singly or in combination at different seasons

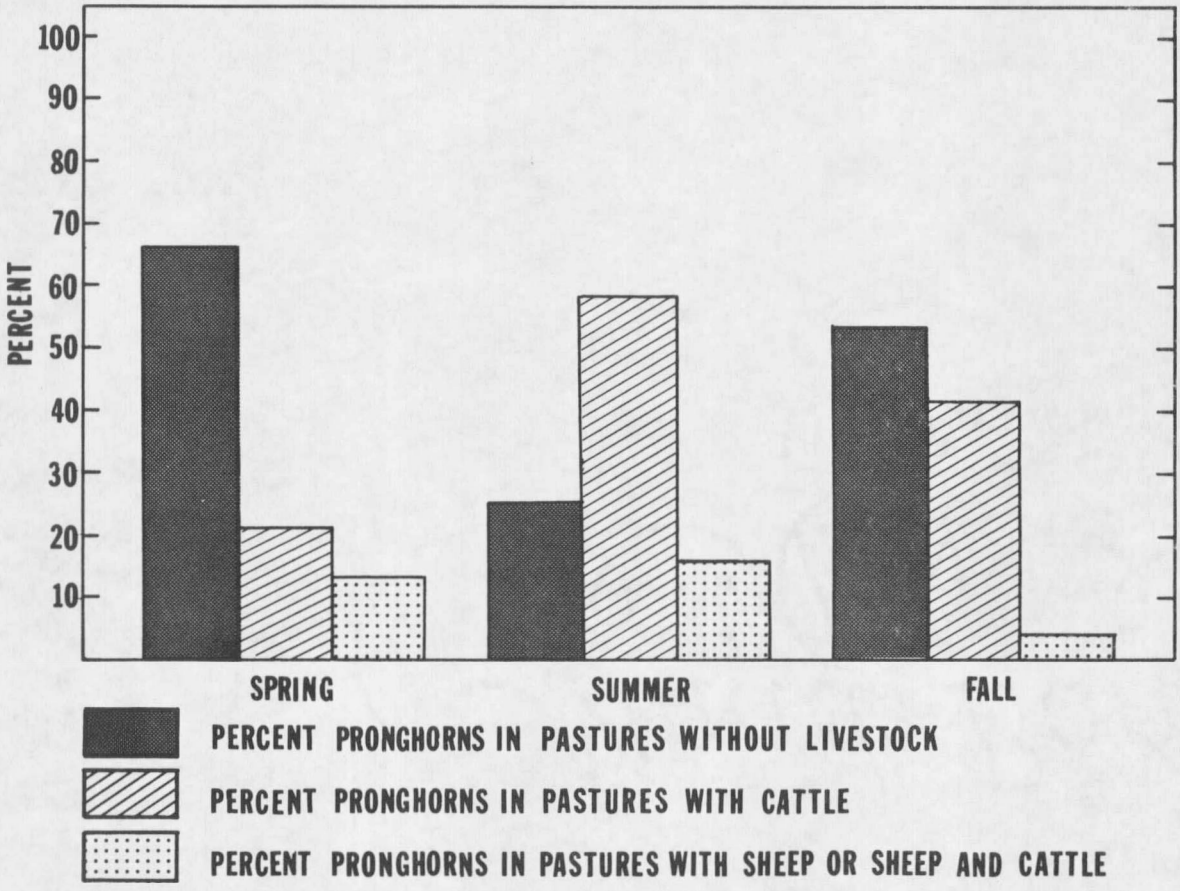

Figure 16. Seasonal pronghorn distribution among pastures in relationship to livestock.

TABLE 11. PERCENT SEASONAL PASTURE OCCUPANCY BASED ON TOTAL NUMBER OF PASTURES.

	Spring	Summer	Fall
Percent Pastures Occupied Solely by Pronghorns	36.3	26.2	37.7
Percent Pastures Occupied by Cattle[1]	13.0	24.6	20.3
Percent Pastures Occupied by Sheep or Sheep and Cattle[1]	20.3	30.4	20.3
Percent Pastures Unoccupied	30.4	18.8	21.7

[1] = Pronghorns may have been present also.

may have been responsible for pronghorn use or non-use of certain pastures. The greater-than-expected pronghorn use during all three seasons of pastures occupied by cattle indicates a compatibility between the two species. Buechner (1950) and others have suggested the same relationship. Pronghorn use of pastures occupied by sheep was 35, 57 and 80 percent below the expected for spring, summer and fall, respectively. The below expected pronghorn use indicated an all-season non-compatible pronghorn-sheep relationship. This is in direct conflict with the findings of Severson *et al.* (1968) who found that pronghorns often feed and water with sheep. The seasonal use trend suggests that the relationship may have existed due to forb availability and forage competition. A decreasing seasonal availability of forbs results from seasonal weather changes (increased temperatures and decreased precipi-

tation as summer progresses) and from sheep usage. Forage competition is discussed in the interspecific range relationships section. Pronghorn use was never detected for 12 pastures with a past history of heavy sheep use. These 12 pastures occupied 14.7 percent of the study area. The effects of heavy sheep use on number of forb species, total forb canopy coverage, and frequency are shown in Table 2. Other pastures (Figures 13 to 15) may not show pronghorn use, due to less than 1 percent of the total observations for any given season being recorded for a specific pasture.

For those pronghorns whose livestock association was with cattle, 38.6 percent of all individual observations and 39.1 percent of all group observations were within one-quarter mile of cattle (Table 12). Only 4.2 and 5.3 percent of pronghorn individuals and groups associated with sheep were observed within one-quarter mile of sheep, respectively. These data lend further support to the existence of a non-compatible pronghorn-sheep relationship.

Pronghorn-Livestock Food Habits

PRONGHORNS

From April to September, 1969, 49 feeding sites were examined on various habitat types and 7,970 instances of use were recorded (Tables 13 and 14). Thirteen rumens were also analyzed for the same period and seasonal tabulations appear in Table 13.

TABLE 12. PRONGHORN-LIVESTOCK ASSOCIATIONS FOR INDIVIDUAL PRONGHORN OBSERVATIONS AND PRONGHORN GROUPS.

Association Class[1]	Pronghorns Associated with Cattle		Pronghorns Associated with Sheep	
	Individual[2]/ Percent[3]	Groups[4]/ Percent[5]	Individual/ Percent	Groups/ Percent
00 = >1 Mile	117/11.5	16/ 9.4	50/26.3	9/23.7
01 = ∿1 Mile	117/11.5	14/ 8.2	20/10.5	4/10.5
02 = ∿3/4 Mile	112/11.0	20/11.7	56/29.5	11/28.9
03 = ∿1/2 Mile	278/27.4	54/31.6	56/29.5	12/31.6
04 = ∿1/4 Mile	252/24.8	42/24.5	0/ 0.0	0/ 0.0
05 = <1/4 Mile	140/13.8	25/14.6	8/ 4.2	2/ 5.3
Total	1,016/84.3	171/81.8	190/15.7	38/18.2

[1] = Proximity to the nearest one-quarter mile of pronghorn to livestock.
[2] = Actual number of individual pronghorns observed for each class.
[3] = Percent of individuals for each class for which association data were recorded.
[4] = Number of pronghorn groups observed for each class.
[5] = Percent of groups for each class for which association data was recorded.

Feeding site data indicated that grass was of little importance in all three seasons and never exceeded 4 percent of the seasonal diet. Rumen analyses data also indicated minor use of grass but at a greater level than indicated by feeding sites for late spring. Difficulty in detecting grass use at feeding sites probably accounts for the discrepancy. Greater use of grass in spring as compared to other seasons is probably due to an earlier availability of this forage class. Summer and fall grass use was about the same for both methods. This trend in grass use, as shown by rumen analyses data, is in general agreement

TABLE 13. SEASONAL AND MONTHLY FOOD HABITS OF PRONGHORNS AS DETERMINED BY EXAMINATION OF 49 FEEDING SITES AND ANALYSES OF 13 RUMEN SAMPLES IN 1969.

	LATE SPRING				SUMMER					EARLY FALL	
	April	May	Season Average		June	July	August	Season Average		September	
Taxa[1]	(8)[2] (1144)[3]	(9) (1835)	(17) (2979)	4 Rumens	(7) (1094)	(8) (1375)	(9) (1123)	(24) (3592)	7 Rumens	(8) (1399)	2 Rumens
GRASSES AND GRASS-LIKE PLANTS:											
Agropyron smithii	38/ 1[4]	22/ 1	30/ 1	--	--	50/ 1	33/ +	29/ +	--	50/ 2	--
Avena sativa	--	--	--	--	14/ 7	--	--	--	--	--	--
Buchloe dactyloides	--	--	--	--	--	--	11/ 1	3/ +	--	--	--
Graminae	--	--	--	100/14	--	--	--	--	100/ 4	--	100/ 4
Total Grasses	50/ 2	22/ 1	38/ 2	100/14	14/ 7	63/ 2	56/ 3	44/ 4	100/ 4	50/ 3	100/ 4
SHRUBS:											
Artemisia cana	13/36	--	6/17	25/11	14/ 3	--	11/ 4	8/ 2	22/ 1	13/ 5	--
Artemisia tridentata	63/15	33/12	48/14	100/36	--	13/ 8	22/ 5	12/ 4	78/ 3	50/15	100/22
Atriplex nuttallii	--	--	--	--	--	25/ +	22/ 1	16/ +	--	--	--
Chrysothamnus viscidiflorus	--	--	--	--	--	13/ 8	--	4/ 3	17/ +	13/13	--
Gutierrezia sarothrae	--	22/ 1	11/ +	--	14/ 1	13/ +	22/ 3	16/ 1	22/ +	13/ +	50/ 2
Rosa spp.	--	--	--	--	--	--	--	--	56/ 4	--	--
Sarcobatus vermiculatus	--	22/ 3	11/ 2	--	14/ 3	--	11/ +	8/ 1	--	--	--
Symphoricarpos occidentalis	13/ 2	--	6/ 1	--	--	--	--	--	22/ 1	--	--
Unidentified Shrubs	--	--	--	100/ +	--	--	--	--	50/ +	--	50/ 4
Total Shrubs	88/53	55/16	72/34	100/47	43/ 8	38/16	78/13	53/12	100/10	63/34	100/28
FORBS:											
Achillea millefolium	--	33/19	16/10	25/ +	14/ 3	13/ +	—	9/ 1	44/ 1	--	50/ +
Allium textile	38/ 2	22/ +	30/ 1	--	--	--	--	--	--	--	--
Antennaria parviflora	--	11/ +	6/ +	--	--	--	--	--	--	--	50/ 2
Arnica fulgens	--	22/ 2	11/ 1	--	--	--	--	--	--	--	--
Artemisia frigida	--	--	--	--	14/ 2	13/ 2	--	9/1	44/ 1	--	100/ 2
Artemisia longifolia	--	--	--	--	14/ 2	--	11/ +	9/ +	--	25/ 2	--
Aster falcatus	--	22/ 6	11/ 3	--	57/19	50/17	44/ 2	50/13	72/13	38/ 1	50/ 4
Astragalus gilviflorus	--	--	--	--	--	13/ +	44/ 3	19/ 1	--	--	50/ 3
Astragalus missouriensis	--	--	--	--	--	--	33/ 5	11/ 2	--	13/ +	--
Atriplex argentea	--	--	--	--	--	--	11/ 1	4/ +	--	--	--
Besseya wyomingensis	13/ 1	--	6/ +	--	--	--	--	--	--	--	--
Comandra umbellata	--	56/18	28/ 9	--	29/ +	25/ +	--	18/ +	56/ +	13/ +	--
Echinacea pallida	--	--	--	--	--	--	--	--	11/ +	--	--
Erigeron pumilus	--	--	--	--	--	--	--	--	17/ 1	--	--
Eriogonum multiceps	--	--	--	--	--	--	11/ +	4/ +	--	13/ 3	--
Helianthus petiolaris	--	--	--	--	14/ +	--	--	5/ +	--	13/ 1	--
Kochia scoparia	--	--	--	--	--	--	1/ 1	+/ +	--	--	--
Lactuca pulchella	--	--	--	--	--	--	--	--	17/ 1	--	--
Lactuca serriola	--	--	--	--	--	--	--	--	17/ +	--	--
Lepidium densiflorum	--	--	--	25/ +	29/21	--	--	10/ 7	29/ 2	--	--
Lomatium foeniculaceum	63/26	44/20	54/23	100/18	14/ +	--	--	5/ +	17/ +	--	--
Lomatium macrocarpum	50/13	33/ 5	44/ 9	100/15	--	--	--	--	17/ +	--	--
Melilotus officinalis	--	22/ 1	11/ +	25/ +	43/ 9	50/44	22/ 9	38/21	63/18	88/47	100/24
Monolepis nuttalliana	--	11/ 2	6/ 1	25/ +	29/ 5	--	11/ +	13/ 2	--	--	--
Oenothera caespitosa	--	11/ +	6/ +	--	--	--	--	--	--	--	--
Penstemon eriantherus	--	--	--	--	43/ 1	13/ +	11/ +	22/ +	--	--	--
Petalostemon candidum	--	--	--	--	14/ 1	13/ 2	33/20	20/ 8	62/ 8	--	--
Petalostemon purpureus	--	11/ +	6/ +	--	29/15	38/ 6	44/ 3	37/ 8	56/ 3	38/ 4	--
Polygala alba	--	--	--	--	--	--	22/12	7/ 4	11/ +	--	--
Polgonum ramosissimum	--	--	--	25/ 4	14/ 4	--	22/10	12/ 5	78/ 8	--	50/ 2
Psoralea argophylla	--	11/ 2	6/1	--	--	--	11/ +	4/ +	--	--	--
Ratibida columnifera	--	11/ 1	6/+	--	--	13/ +	--	4/ +	17/ 1	--	--
Rumex crispus	--	--	--	--	--	--	--	--	17/ 2	--	50/ 3
Sphaeralcea coccinea	--	--	--	--	14/ +	13/ +	22/ 1	16/ +	44/ 2	25/ +	50/ +
Taraxacum officinale	--	--	--	--	--	13/ 1	--	4/ +	--	--	--
Tragopogon dubius	--	--	--	--	--	38/ 3	22/ 2	20/ 2	29/ +	13/ +	--
Vicia americana	25/ +	44/ 2	35/ 1	75/14	43/ 1	38/ 3	67/ 8	49/ 4	89/ 4	38/ 1	--
Viola nuttallii	--	22/ +	11/ +	--	14/ 1	--	--	50/ +	--	--	--
Unidentified Forbs	13/ 2	11/ +	12/ 1	50/ 1	--	--	--	--	100/19	--	100/16
Total Forbs	100/45	89/83	94/64	100/40	100/85	100/82	100/84	100/84	100/85	100/63	100/55
Cactus (*Opuntia polyacantha*)	--	--	--	--	14/ 1	13/ +	--	9/ +	33/ 1	--	100/12

[1] = Includes only those species which constituted 1.0 percent or more of the diet for at least 1 month. Those with lesser values are: *Agropyron* spp., *Bouteloua gracilis*, *Hordeum jubatum*, *Koeleria cristata*, *Muhlenbergia cuspidata*, *Poa* spp., *Stipa viridula*, *Salix* spp., *Astragalus* spp., *Astragalus bisulcatus*, *Astragalus striatus*, *Bahia oppositifolia*, *Colomia linearis*, *Cirsium undulatum*, *Cryptanthe bradburiana*, *Descurainia sophia*, *Epilobium paniculatum*, *Eriogonum flavum*, *Gaura coccinea*, *Gilia congesta*, *Glycyrrhiza lepidota*, *Grindellia squarrosa*, *Haplopappus spinulosus*, *Hymenoxys acaulis*, *Iva axillaris*, *Liatris punctata*, *Linum rigidum*, *Microsteris gracilis*, *Penstemon* spp., *Zigadenus paniculatus*.

[2] = Number of feeding sites.

[3] = Instances of use.

[4] = __/__ Percent frequency of occurrence in feeding sites or rumens/Percent of the diet. + Indicates value less than 1 percent.

TABLE 14. PRONGHORN SEASONAL FOOD HABITS BY HABITAT TYPE FOR 1969 AS INDICATED BY EXAMINATION OF FEEDING SITES.

	HABITAT TYPE AND SEASONS								
	Agropyron-Artemisia			*Agropyron*-Leguminosae-*Gutierrezia*			*Agropyron-Melilotus-Stipa*		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
	(14)[1]	(16)	(3)	(1)	(5)	(3)	(2)	(1)	(2)
Taxa	(2544)[2]	(2169)	(490)	(52)	(889)	(522)	(383)	(49)	(385)
	Fr/%[3]	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%	Fr/%
GRASSES AND GRASS-LIKE PLANTS:									
Agropyron smithii	29/ 1	31/ 1	33/ 1	--	40/ 1	33/ 1	50/ 1	--	100/ 6
Agropyron spp.	7/ +	--	--	--	--	--	--	--	--
Buchloe dactyloides	--	--	--	--	20/ 1	--	--	--	--
Hordeum jubatum	--	6/ +	--	--	--	--	--	--	--
Koeleria cristata	--	--	33/ 1	--	--	--	--	--	--
Muhlenbergia cuspidata	--	--	--	--	20/ +	--	--	--	--
Poa spp.	7/ +	--	--	--	20/ +	--	--	--	50/ 1
Stipa viridula	--	--	--	--	20/ +	--	--	--	--
Total Grasses	31/ 2	38/ 1	33/ 2	--	60/ 3	33/ 1	50/ 1	--	100/ 7
SHRUBS:									
Artemisia cana	7/16	4/12	--	--	--	33/15	--	--	--
Artemisia tridentata	57/16	13/ 7	100/39	--	20/ +	33/ 4	--	--	--
Atriplex nuttallii	--	19/ +	--	--	20/ +	--	--	--	--
Chrysothamnus viscidiflorus	--	6/ 5	--	--	--	33/34	--	--	--
Gutierrezia sarothrae	14/ 1	25/ 2	33/ 1	--	--	--	--	--	--
Sarcobatus vermiculatus	7/ 2	6/ +	--	100/15	20/ 4	--	--	--	--
Symphoricarpos occidentalis	--	--	--	--	--	--	50/ 7	--	--
Total Shrubs	70/34	62/19	100/41	100/15	60/ 5	100/53	50/ 7	--	--
FORBS:									
Achillea millefolium	14/ 1	12/ 2	--	--	--	--	50/87	--	--
Allium textile	31/ 1	--	--	--	--	--	--	--	--
Arnica fulgens	14/ 2	--	--	--	--	--	--	--	--
Antennaria parvifolia	7/ +	--	--	--	--	--	--	--	--
Artemisia frigida	--	12/ 3	--	--	--	--	--	--	--
Artemisia longifolia	--	--	--	--	40/ +	67/ 6	--	--	--
Atriplex argentea	--	6/ +	--	--	--	--	--	--	--
Aster falcatus	14/ 4	50/18	33/ 1	--	60/ 2	67/ 2	--	--	--
Astragalus bisulcatus	7/ 1	--	--	--	20/ +	--	--	--	--
Astragalus gilviflorus	--	12/ +	--	--	40/ 3	--	--	--	--
Astragalus missouriensis	--	6/ 2	33/ 2	--	40/ 1	--	--	--	--
Bahia oppositifolia	--	--	--	--	20/ +	--	--	--	--
Besseya wyomingensis	--	--	--	--	--	--	50/ 3	--	--
Colomia linearis	7/ +	--	--	--	--	--	--	--	--
Comandra umbellata	31/12	19/ +	33/ 1	100/50	--	--	--	--	--
Cirsium undulatum	--	6/ +	--	--	--	--	--	--	--
Crypthanthe bradburiana	--	--	--	--	--	33/ 1	--	--	--
Eriogonum flavum	--	--	--	--	20/ 1	--	--	--	--
Eriogonum multiceps	--	--	--	--	20/ +	33/ 8	--	--	--
Gaura coccinea	--	6/ +	--	--	20/ +	33/ 1	--	--	--
Gilia congesta	--	12/ +	--	--	--	--	--	--	--
Glycyrrhiza lepidota	--	6/ +	--	--	20/ 1	--	--	--	--
Grindellia squarrosa	--	6/ +	--	--	20/ +	33/ 1	--	--	--
Haplopappus multicaulis	--	6/ +	--	--	--	--	--	--	--
Haplopappus spinulosus	--	--	--	--	20/ +	--	--	--	--
Helianthus petiolaris	--	--	33/ 4	--	--	--	--	100/12	--
Iva axillaris	--	6/ +	--	--	20/ +	--	--	--	--
Lepidium densiflorum	--	6/ +	--	--	--	--	--	--	--
Linum rigidum	--	--	--	--	20/ +	--	--	--	--
Lomatium foeniculaceum	26/56	--	--	--	--	--	--	--	--
Lomatium macrocarpum	38/ 9	--	--	--	--	--	--	--	--
Melilotus officinalis	7/ +	38/29	67/48	100/35	60/21	100/13	--	--	100/93
Microsteris gracilis	7/ 1	--	--	--	--	--	--	--	--
Monolepis nuttalliana	7/ 1	6/ +	--	--	--	--	--	100/ 4	--
Oenothera caespitosa	7/ +	--	--	--	--	--	--	--	--
Penstemon spp.	7/ +	--	--	--	--	--	--	--	--
Penstemon eriantherus	--	25/ 1	--	--	20/ +	--	--	--	--
Petalostemon candidum	--	12/ 3	--	--	40/20	--	--	--	--
Petalostemon purpureus	7/ 1	31/ 4	--	--	60/19	100/12	--	--	--
Polygala alba	--	--	--	--	40/15	--	--	--	--
Polygonum ramosissimum	--	12/ 5	--	--	--	--	--	100/84	--
Psoralea argophylla	7/ 1	--	--	--	20/ +	--	--	--	--
Ratibida columnifera	7/ 1	--	--	--	--	--	--	--	--
Sphaeralcea coccinea	--	25/ 1	67/ 1	--	--	--	--	--	--
Taraxacum officinale	--	6/ 1	--	--	--	--	--	--	--
Tragopogon dubius	--	19/ 2	--	--	40/ 2	33/ 1	--	--	--
Vicia americana	31/ 1	56/ 6	33/ 1	--	40/ 2	67/ 2	50/ 2	--	--
Viola nuttallii	14/ 1	6/ +	--	--	--	--	--	--	--
Zigadenus paniculatus	7/ +	--	--	--	--	--	--	--	--
Unidentified Forbs	14/ 1	--	--	--	--	--	--	--	--
Total Forbs	100/64	100/80	100/57	100/85	100/93	100/46	100/92	100/100	100/93

[1] = Number of feeding sites.
[2] = Instances of use.
[3] = Frequency of use among feeding sites/percent of diet. + Indicates value less than 1 percent.

with Dirschl (1963).

For late spring, summer and early fall, feeding site data indicated that shrubs comprised 34, 12 and 34 percent of the diet, respectively. The monthly trend (April-September) followed that for seasons. This seasonal and monthly trend corresponded with general availability of succulent forbs over the entire area. Percent shrub usage on the *Agropyron-Artemisia* habitat type was greater than percent shrub abundance (as measured by canopy coverage) for all seasons (Tables 14 and 1), whereas on the *Agropyron*-Leguminosae-*Gutierrezia* habitat type, the only other type where shrub use was important, use was above the abundance for late spring and early fall but below for summer. A 67 and 44 percent decline in shrub use occurred from late spring to summer on the *Agropyron*-Leguminosae-*Gutierrezia* and *Agropyron-Artemisia* types, respectively. This decline corresponded with the period of peak forb abundance and reflected the greater abundance of succulent forbs on the former type. The large increase in use of shrubs for early fall on the *Agropyron*-Leguminosae-*Gutierrezia* type suggested that part of the increased use of this type may be due to the presence of certain shrubs as well as an abundance of succulent forbs. *Chrysothamnus viscidiflorus* accounted for most of the fall increase in shrub usage and occurred almost exclusively on this type.

Artemisia cana and *Artemisia tridentata* were the two most utilized shrubs in late spring and together made up 31 percent of the total diet.

The greatest use of these two species occurred on the *Agropyron-Artemisia* type where utilization exceeded abundance in the plant community. *Artemisia cana* was used far in excess of its abundance suggesting a definite preference for this species. Grimm (1939) and many others since, have noted the importance of "shrubby sage" species (*Artemisia* spp.) in the diet of the pronghorn.

Use of *Sarcobatus vermiculatus* occurred in the spring when leader growth was just starting and again in summer when above normal precipitation stimulated regrowth (Table 18, Appendix). Most of the use of this species occurred on the *Agropyron*-Leguminosae-*Gutierrezia* type and exceeded its abundance for both periods indicating a preference for the new leaders of this species.

Shrub utilization as determined from rumen analyses followed the same trend as that indicated by feeding site examinations.

Forb use for each month exceeded the use of grasses and grass-like plants and shrubs for all months except April. Forb use also exceeded the relative abundance of forbs on all habitat types. Four species, *Achillea millefolium, Comandra umbellata, Lomatium foeniculaceum* and *L. macrocarpum,* together made up 51 percent of the spring diet. For summer, use shifted to *Melilotus officinalis* and *Aster falcatus* and for fall almost entirely to the former which made up 47 percent of the fall diet. *Achillea millefolium,* one of the few early-occurring forbs on the *Agropyron-Melilotus-Stipa* type, made up 87 percent of the spring

diet on this type and was relatively unimportant on the other habitat types. Probably the most important single forb at least during summer and fall on all habitat types was *Melilotus officinalis*. Couey (1946) and Buck (1947), working in the same general area in which this study was conducted, noted the most common forbs found in rumen samples collected during the fall period, but did not list the exotic *Melilotus officinalis* which in this study made up a major portion of the fall diet.

Seasonal forb use trends as determined by rumen analyses, followed that shown by feeding site examinations, with the same species being important for similar periods for both methods.

Cole (1956), Wentland (1968) and Roberts (1970) noted similar seasonal forage class use trends as determined by feeding site examinations. Mason (1952), Severson *et al.* (1968) and Buechner (1947) reported rumen analyses data which showed similar seasonal forage class use.

SHEEP

Twenty-two sheep feeding sites were examined between April and September, 1969 and 5,826 instances of use were recorded (Table 15).

Grasses and grass-like plants made up 31, 48 and 73 percent of the late spring, summer and early fall diets, respectively. During April, May and June, use of grass and grass-like plants remained about

TABLE 15. SHEEP FOOD HABITS FOR LATE SPRING, SUMMER AND EARLY FALL AS DETERMINED BY EXAMINATION OF 22 FEEDING SITES IN 1969.

	LATE SPRING			SUMMER				EARLY FALL
	April	May	Season Average	June	July	August	Season Average	Sept.
	(3)[2]	(4)	(7)	(3)	(4)	(5)	(12)	(3)
Taxa[1]	(862)[3]	(755)	(1617)	(753)	(1568)	(1165)	(3486)	(723)
GRASSES AND GRASS-LIKE PLANTS:								
Agropyron desertorum	--	--	--	--	25/ 1	--	8/ +	--
Agropyron smithii	100/15[4]	100/22	100/18	100/28	100/32	100/56	100/39	100/38
Bouteloua gracilis	--	--	--	--	25/ 2	20/ 4	15/ 2	33/ 1
Bromus japonicus	--	--	--	33/ 1	--	--	11/ +	--
Buchloe dactyloides	33/11	25/ +	29/ 6	--	25/ +	--	8/ +	67/ 9
Carex spp.	--	--	--	--	25/ 1	20/ +	15/ +	33/10
Carex filifolia	33/ +	--	16/ +	33/ 2	--	--	11/ 1	--
Koeleria cristata	--	25/ 2	12/ 1	--	25/ +	40/ +	22/ +	--
Muhlenbergia cuspidata	--	--	--	--	25/ 2	--	8/ 1	--
Poa spp.	33/ +	25/ 3	29/ 2	33/ 1	50/ 2	20/ 1	34/ 1	--
Stipa viridula	33/ 6	--	16/ 3	--	75/ 1	60/ 7	45/ 3	100/14
Unidentified Grasses	--	25/ 2	12/ 1	--	--	--	--	--
Total Grasses	100/34	100/28	100/31	100/32	100/42	100/70	100/48	100/73
SHRUBS:								
Artemisia cana	--	--	--	--	--	20/ +	7/ +	67/ 8
Artemisia tridentata	100/49	50/ +	75/25	--	25/ 6	20/ +	15/ 2	33/ +
Atriplex nuttallii	67/ 8	--	33/ 4	67/ 5	50/ 1	40/ 6	52/ 4	--
Sarcobatus vermiculatus	--	25/31	12/16	--	25/19	--	8/ 6	--
Total Shrubs	100/57	75/32	88/44	67/ 6	75/26	80/ 8	74/13	67/ 9

TABLE 15. (CONTINUED).

Taxa	LATE SPRING			SUMMER				EARLY FALL
	April (3) (862)	May (4) (755)	Season Average (7) (1617)	June (3) (753)	July (4) (1568)	August (5) (1165)	Season Average (12) (3486)	Sept. (3) (723)
FORBS:								
Achillea millefolium	--	50/ 1	25/ +	--	25/ +	40/ +	22/ +	--
Artemisia frigida	--	--	--	--	--	40/ +	13/ +	33/ 2
Astragalus bisulcatus	--	--	--	33/18	50/ 2	20/ 4	34/ 8	--
Astragalus cibarius	--	--	--	--	25/ 1	60/ 3	28/ 1	33/ +
Atriplex dioeca	--	--	--	--	25/ 3	--	8/ 1	--
Chenopodium leptophyllum	--	--	--	--	--	20/ 2	7/ 1	--
Epilobium paniculatum	--	--	--	--	25/ 1	--	8/ +	--
Eriogonom multiceps	--	--	--	--	25/15	--	8/ 5	--
Gaura coccinea	--	--	--	33/ 4	--	--	11/ 1	--
Helianthus petiolaris	--	--	--	--	25/ 3	20/ +	15/ 1	--
Iva axillaris	--	--	--	67/11	25/ 2	--	31/ 4	--
Lomatium foeniculaceum	--	25/13	12/ 6	--	--	--	--	--
Lomatium macrocarpum	--	25/ 4	12/ 2	33/ +	--	--	11/ +	--
Melilotus officinalis	--	25/13	12/ 6	--	50/ 2	20/ +	23/ 1	33/14
Monolepis nuttalliana	--	--	--	33/ 4	--	--	11/ 1	--
Plantago purshii	--	--	--	33/ +	25/ 1	--	19/ +	--
Polygonum ramosissimum	--	--	--	--	--	40/ 2	13/ 1	--
Ratibida columnifera	--	25/ 3	12/ 2	--	--	--	--	--
Rumex crispus	--	--	--	--	--	20/ 1	7/ +	--
Sphaeralcea coccinea	--	25/ +	12/ +	67/18	25/ +	40/ 5	44/ 8	--
Taraxacum officinale	--	--	--	33/ 4	--	40/ 2	26/ 2	--
Tragopogon dubius	--	--	--	33/ +	--	40/ +	26/ +	33/ 1

TABLE 15. (CONTINUED).

Taxa	LATE SPRING			SUMMER				EARLY FALL
	April (3) (862)	May (4) (755)	Season Average (7) (1617)	June (3) (753)	July (4) (1568)	August (5) (1165)	Season Average (12) (3486)	Sept. (3) (723)
FORBS (continued):								
Vicia americana	100/ 6	50/ 4	75/ 5	--	25/ +	60/ +	28/ +	--
Viola nuttallii	33/ 2	--	16/ 1	33/ +	--	--	11/ +	--
Unidentified Forbs	33/ 2	--	16/ 1	--	--	--	--	--
Total Forbs	100/10	50/40	75/25	100/62	75/32	100/22	92/39	67/18

[1] = Includes only those species which constituted 1 percent or more of the diet for at least 1 month. Those with lesser values are: *Andropogon scoparius, Festuca octoflora, Hordeum jubatum, Schedonnardus paniculatus, Gutierrezia sarothrae, Symphoricarpos occidentalis, Artemisia ludoviciana, Aster falcatus, Astragalus gilviflorus, Besseya wyomingensis, Comandra umbellata, Grindelia squarrosa, Haplopappus multicaulis, Lepidium densiflorum, Linum rigidum, Oenothera caespitosa, Penstemon* spp., *Petalostemon purpureus, Polygonum* spp., *Taraxacum laevigatum, Opuntia polycantha.*

[2] = Number of feeding sites.

[3] = Instances of use.

[4] = __/__ Percent frequency of occurrence in feeding sites/Percent of the diet. + Indicates values less than 1 percent.

constant but increased in July to where this forage class became the main portion of the diet and remained so through September. This shift coincided with the decreased forb availability which was especially noticeable in sheep pastures with a past history of over use. Grass utilization on these pastures was about equal to abundance for the months of August and September. *Agropyron smithii* was the most used grass species by month and season making up at least 50 percent of all grass utilization for each season and comprising 18, 39 and 38 percent of the late spring, summer and early fall diets, respectively.

Shrub use during late spring, summer and early fall was 44, 13 and 19 percent, respectively. Shrubs were the major items in the late spring diet and were the least important items in summer and early fall. *Artemisia tridentata* and *Sarcobatus vermiculatus* were the most utilized species for late spring and were used in excess of their abundance. This usage may be due to availability rather than preference as new forb and grass growth did not become readily available until about the middle of May. Sheep use of *Sarcobatus vermiculatus* followed the same pattern as that shown for pronghorns.

Forbs which comprised 25, 39 and 18 percent of the late spring, summer and early fall diets, respectively, were never the dominant items in the diet when considered by season; however by month, they were dominant for May and June. Forb utilization in May, June and July was greater than forb abundance on either the *Agropyron-Artemisia* type or the

sheep pastures with a past history of over use. These changes in forb use typify the roles that availability and preference play in influencing food habits. Three forb species, *Lomatium foeniculaceum*, *Melilotus officinalis* and *Vicia americana*, made up 68 percent of all forb utilization in late spring and comprised 17 percent of the total diet for this period. *Astragalus bisulcatus* and *Sphaeralcea coccinea* were important species during the summer. *Melilotus officinalis*, which was almost completely lacking in sheep pastures with a past history of over use, made up only 1 percent of the summer diet. The large percentage of the early fall diet made up by *Melilotus officinalis* (14 percent) possibly exaggerated the importance of this species. This was because all three feeding sites for early fall were taken in pastures where sheep had not been grazed for several years prior to the study and in which *Melilotus officinalis* was somewhat abundant.

VanDyne and Heady (1965) reported similar sheep use of grasses and grass-like plants, forbs and shrubs for the summer period.

CATTLE

Between April and September, 1969, 5,067 instances of use were recorded at 23 cattle feeding sites (Table 16).

Grasses and grass-like plants were the dominant items in the diet of cattle during all three seasons and comprised 74, 74 and 86 percent of the spring, summer and fall diets, respectively. *Agropyron smithii*

TABLE 16. CATTLE FOOD HABITS FOR LATE SPRING, SUMMER AND EARLY FALL AS DETERMINED BY EXAMINATION OF 23 FEEDING SITES IN 1969.

	LATE SPRING			SUMMER				EARLY FALL
	April	May	Season Average	June	July	August	Season Average	Sept.
Taxa[1]	(3)[2] (593)[3]	(3) (533)	(6) (1126)	(4) (1258)	(4) (869)	(4) (834)	(12) (3061)	(5) (1080)
GRASSES AND GRASS-LIKE PLANTS:								
Agropyron smithii	100/59[4]	100/69	100/64	100/46	100/66	100/37	100/48	100/68
Bouteloua gracilis	--	--	--	--	25/ 2	50/ 2	25/ 1	20/ +
Bromus japonicus	--	--	--	50/ 6	--	--	17/ 2	--
Buchloe dactyloides	--	--	--	25/ 3	50/10	50/ 8	42/ 7	20/10
Carex spp.	--	--	--	25/ +	25/ 1	--	17/ +	--
Hordeum jubatum	--	--	--	25/ 4	--	50/ 2	25/ 2	--
Koeleria cristata	--	--	--	--	--	25/ 2	8/ 1	20/ +
Muhlenbergia cuspidata	--	--	--	--	--	--	--	20/ 2
Poa spp.	33/ 3	67/ 4	50/ 4	50/ 2	25/ +	--	25/ 1	-
Schedonnardus paniculatus	--	--	--	--	25/13	25/ +	17/ 4	20/ +
Spartina pectinata	--	--	--	25/ 4	--	--	8/ 1	--
Stipa viridula	33/12	33/ 2	33/ 7	50/ 6	50/ 5	75/12	58/ 8	40/ 4
Total Grasses	100/73	100/75	100/74	100/71	100/86	100/66	100/74	100/86
SHRUBS:								
Symphoricarpos occidentalis	-	--	--	--	--	--	--	20/ 3
Total Shrubs	--	--	--	25/ +	25/ +	50/ 1	33/ +	40/ 4
FORBS:								
Allium textile	--	33/ 6	16/ 3	--	--	--	--	--
Aster falcatus	--	33/ 2	16/ 1	50/ +	25/ +	--	25/ +	--
Atriplex argentea	--	--	--	--	--	25/ 2	8/ 1	--
Grindelia squarrosa	--	--	--	25/ +	50/ 1	--	25/ +	--
Iva axillaris	--	67/10	33/ 5	25/ 5	50/ 4	25/ +	33/ 3	40/ 4
Lepidium densiflorum	--	--	--	--	25/ 2	--	8/ 1	--
Lomatium foeniculaceum	67/15	33/ 1	50/ 8	25/ +	--	--	8/ 1	--
Lomatium macrocarpum	100/17	33/ 3	66/10	25/ +	--	--	8/ +	--

TABLE 16. (CONTINUED).

Taxa	LATE SPRING			SUMMER				EARLY FALL
	April	May	Season Average	June	July	August	Season Average	Sept.
	(3)	(3)	(6)	(4)	(4)	(4)	(12)	(5)
	(593)	(533)	(1126)	(1258)	(869)	(834)	(3061)	(1080)
FORBS (continued):								
Medicago sativa	--	--	--	50/ 2	--	25/16	25/ 6	--
Melilotus officinalis	--	--	--	25/12	25/ +	50/ 5	33/ 6	
Plantago purshii	--	--	--	--	25/ 1	--	8/ +	--
Polygonum ramosissimum	--	--	--	--	--	25/ +	8/ +	20/ 1
Ratibida columnifera	--	--	--	--	--	--	--	20/ 2
Sphaeralcea coccinea	--	--	--	25/ +	25/ +	75/ 1	42/ +	20/ +
Taraxacum officinale	--	--	--	25/ +	--	50/ 1	25/ +	--
Tragopogon dubius	--	--	--	25/ +	--	75/ 4	33/ 1	20/ +
Vicia americana	--	67/ 3	33/ 1	50/ 2	75/ 2	50/ 2	58/ 2	20/ 1
Xanthium strumarium	--	--	--	50/ 1	--	25/ +	25/ +	--
Total Forbs	100/27	100/25	100/26	100/28	100/13	100/33	100/25	80/10

[1] = Includes only those species which constituted 1 percent or more of the diet for at least 1 month. Those with lesser values are: *Carex filifolia, Distichlis stricta, Atriplex nuttallii, Gutierrezia sarothrae, Populus deltoides, Rosa* spp., *Sarcobatus vermiculatus, Achillea millefolium, Astragalus canadensis, Astragalus cibarius, Astragalus gilviflorus, Astragalus missouriensis, Bahia oppositifolia, Cirsium undulatum, Glycyrrhiza lepidota, Helianthus petiolaris, Kuhnia eupatoriodes, Microseris cuspidata, Monolepis nuttalliana, Rumex crispus, Solidago mollis.*

[2] = Number of feeding sites.

[3] = Instances of use.

[4] = __/__ Percent frequency of occurrence in feeding sites/Percent of the diet. + Indicates value less than 1 percent.

received the greatest use of all grasses in all three seasons and made up 86, 65 and 79 percent of the total use of grass and grass-like plants in late spring, summer and early fall, respectively. It was also the major item in the diet during each of the three seasons and averaged 60 percent of the total diet for all seasons combined. The increased grass usage for early fall corresponded with the decreasing availability of forbs, which suggests that the increased use of grass and grass-like plants was not due to preference but due to availability.

Shrub use was insignificant in all three seasons and at no time exceeded shrub abundance on any habitat type except the *Agropyron-Melilotus-Stipa* type where shrubs were present only in draws.

Forb usage remained about constant during late spring and summer (26 and 25 percent, respectively) and decreased considerably in early fall (10 percent). *Lomatium foeniculaceum* and *L. macrocarpum* made up 70 percent of the total forb usage in late spring, but only made up 18 percent of the total late spring diet. Important forbs in the summer diet were *Medicago sativa* and *Melilotus officinalis;* and in the early fall diet, *Iva axillaris*.

Mackie (1970) reported similar seasonal forage class use and species used by cattle for an area in northcentral Montana. Summer food habits of cattle reported by Stevens (1966) were also in agreement with my findings.

Chemical Analyses of Forage Plants

To establish a reference for future range condition analyses with respect to chemical composition of game animal diets and to determine if any correlation existed between chemical composition of certain plant species and degree of utilization by pronghorns, a sample of vegetative material from certain plants in each forage class was collected at monthly intervals and analyzed for various chemical constituents (Table 17).

Crude protein levels for major forage species were generally greater when peak utilization of the species occurred than for any other time period. *Artemisia cana* and *Sarcobatus vermiculatus*, two preferred shrubs in late spring, had the greatest percentage of crude protein for the late spring period than any other shrub sampled for that period. Peak utilization of these species occurred when percent crude fiber was at its lowest level. These data suggest a preference for shrubs, during the late spring period, with the greatest protein content and lowest crude fiber content. *Melilotus officinalis*, the major constituent of the summer and early fall diets, had a greater monthly crude protein content than any other plant sampled for each month during the summer and early fall periods. The only other plant with somewhat similar monthly percentages for crude protein content was *Sarcobatus vermiculatus* and these monthly samples consisted mostly of new leader growth that had been stimulated by larger than normal amounts of precipitation during June

TABLE 17. FORAGE PLANTS AND THEIR CHEMICAL COMPOSITION AT VARIOUS CHRONOLOGICAL DATES AND PHENOLOGICAL STAGES.

Taxa	Collection Date	CP[1]	EE[2]	ASH	CF[3]	CA[4]	P[5]	Phenological Stage[6]
Agropyron smithii	April, 1969	13.8	3.0	13.0	28.1	0.08	0.23	I
Agropyron smithii	May, 1969	16.2	3.8	9.7	27.0	0.22	0.29	II
Agropyron smithii	June, 1969	10.2	4.1	7.9	31.1	0.23	0.21	II
Agropyron smithii	July, 1969	9.4	3.5	12.3	31.2	0.14	0.21	III
Agropyron smithii	August, 1969	8.9	5.7	12.8	27.7	0.11	0.14	III
Agropyron smithii	September, 1969	8.5	4.9	8.7	29.3	0.16	0.13	IV
Artemisia frigida	April, 1969	16.3	3.7	6.3	26.8	0.43	0.28	I
Artemisia frigida	May, 1969	16.4	4.9	8.1	26.0	0.39	0.33	I
Artemisia frigida	June, 1969	13.3	5.4	7.4	33.7	0.26	0.25	II
Artemisia frigida	July, 1969	14.0	15.8	6.1	33.1	0.40	0.32	II
Artemisia frigida	August, 1969	12.3	8.6	.46	27.8	0.36	0.26	II
Artemisia frigida	September, 1969	9.1	8.2	4.3	27.9	0.27	0.21	III
Aster falcatus	June, 1969	13.1	2.0	12.9	16.4	0.88	0.51	I
Aster falcatus	July, 1969	11.5	3.1	16.6	17.6	0.74	0.37	II
Aster falcatus	August, 1969	11.9	3.1	8.4	26.6	0.61	0.36	II
Aster falcatus	September, 1969	11.7	3.5	8.6	23.0	0.64	0.31	III
Melilotus officinalis	May, 1969	33.6	2.1	9.5	12.1	0.81	0.46	I
Melilotus officinalis	June, 1969	23.5	2.8	10.0	20.0	0.88	0.41	II
Melilotus officinalis	July, 1969	25.0	2.1	8.2	20.8	0.68	0.34	II
Melilotus officinalis	August, 1969	25.4	2.9	9.3	13.0	1.00	0.26	III
Melilotus officinalis	September, 1969	18.8	2.5	8.0	31.6	1.40	0.20	III & V
Petalostemon spp.	July, 1969	17.8	1.5	9.9	25.4	1.30	0.24	I
Petalostemon spp.	August, 1969	16.2	2.3	7.5	25.4	1.80	0.16	II
Petalostemon spp.	September, 1969	13.1	2.7	6.5	26.1	1.10	0.15	II & III
Artemisia cana	April, 1969	26.2	5.2	8.8	14.5	0.43	0.64	I
Artemisia cana	May, 1969	21.1	6.7	10.0	16.6	0.48	0.67	I
Artemisia cana	June, 1969	15.2	8.6	8.1	20.3	0.31	0.39	I
Artemisia cana	July, 1969	17.2	7.6	6.2	23.5	0.39	0.36	II
Artemisia cana	August, 1969	15.2	8.2	6.7	23.9	0.59	0.33	II
Artemisia cana	September, 1969	12.7	8.3	6.1	23.7	0.49	0.26	III

TABLE 17. (CONTINUED).

Taxa	Collection Date	CP	EE	ASH	CF	CA	P	Phenological Stage
Artemisia tridentata	April, 1969	17.8	6.0	6.4	21.1	0.37	0.32	I
Artemisia tridentata	May, 1969	18.2	6.1	6.9	20.7	0.31	0.42	I
Artemisia tridentata	June, 1969	15.0	8.3	6.4	27.8	0.32	0.38	I
Artemisia tridentata	July, 1969	14.8	8.3	7.6	23.6	0.26	0.34	II
Artemisia tridentata	August, 1969	13.5	10.0	6.7	22.2	0.24	0.28	II
Artemisia tridentata	September, 1969	14.7	8.1	6.4	27.7	0.36	0.38	III
Atriplex nuttallii	April, 1969	24.1	1.3	18.3	17.1	0.25	0.42	I
Atriplex nuttallii	May, 1969	15.9	1.3	33.5	11.4	0.23	0.35	I
Atriplex nuttallii	June, 1969	15.2	1.3	28.9	12.3	0.64	0.27	II
Atriplex nuttallii	July, 1969	16.0	1.0	26.4	15.7	0.43	0.21	II
Atriplex nuttallii	August, 1969	14.8	1.2	24.0	16.4	0.39	0.12	III
Atriplex nuttallii	September, 1969	12.4	2.0	15.6	21.8	0.49	0.11	III & IV
Gutierrezia sarothrae	July, 1969	13.2	9.0	8.9	17.8	0.29	0.24	I
Gutierrezia sarothrae	August, 1969	11.1	12.1	6.6	24.8	0.38	0.22	II
Gutierrezia sarothrae	September, 1969	8.2	12.1	6.1	22.4	0.60	0.12	III
Sarcobatus vermiculatus	April, 1969	33.7	2.0	19.3	10.9	0.16	0.52	I
Sarcobatus vermiculatus	May, 1969	28.3	2.3	23.0	11.9	0.21	0.46	II
Sarcobatus vermiculatus	June, 1969	23.0	2.2	27.1	14.0	0.45	0.43	II
Sarcobatus vermiculatus	July, 1969	15.1	2.1	21.5	20.0	0.15	0.22	III
Sarcobatus vermiculatus	August, 1969	18.6	2.3	21.6	16.8	0.11	0.20	IV & V
Sarcobatus vermiculatus	September, 1969	18.5	2.3	20.6	23.5	0.32	0.19	IV & V

TABLE 17. (CONTINUED).

Taxa	Collection Date	CP	EE	ASH	CF	CA	P	Phenological Stage
Symphoricarpos occidentalis	April, 1969	26.1	2.7	6.4	11.6	0.37	0.56	I
Symphoricarpos occidentalis	May, 1969	19.2	3.9	6.7	10.3	0.42	0.46	I
Symphoricarpos occidentalis	June, 1969	18.3	4.3	7.6	10.4	0.51	0.34	II
Symphoricarpos occidentalis	July, 1969	14.5	3.2	6.8	13.8	0.49	0.38	II
Symphoricarpos occidentalis	August, 1969	10.0	5.0	7.0	14.9	0.98	0.29	III

[1] = Crude protein. [2] = Ether extract. [3] = Crude fiber. [4] = Calcium. [5] = Phosphorus.
[6] = Phenological coding:

I = Leaf bud and leader growth for browse -- 1st top growth for forbs and grasses.
II = Flower stage.
III = Seed mature stage.
IV = Dormant.
V = Regrowth.

and July, 1969.

Protein levels of all species were generally highest the first month of collection and thereafter until the last collection, showed a fairly steady monthly decrease. This trend was also noted by Dirschl (1963).

Einarsen (1956) indicated that a sustaining diet for deer would consist of vegetation with a crude protein level of 5 percent or more. If pronghorn crude protein requirements are anywhere near that for deer, and if crude protein level alone is actually an accurate indicator of nutritive value, then at least the spring, summer and fall diets of pronghorns in this area are above the critical level for crude protein content. Atwood (1948) felt that crude protein levels, by themselves, did not give an accurate indication of the nutritive value of certain forage plants unless a digestibility coefficient for each species was known.

Interspecific Range Relationships

Comparisons of forage class use, (Figure 17) forage species utilized, animal use of the area by time period and pasture occupancy, animal associations, and general seasonal forage supply were made to aid evaluation of range relationships.

PRONGHORNS AND SHEEP

The small percentage of all pronghorns using pastures occupied by sheep in any one season, precluded any severe direct seasonal forage

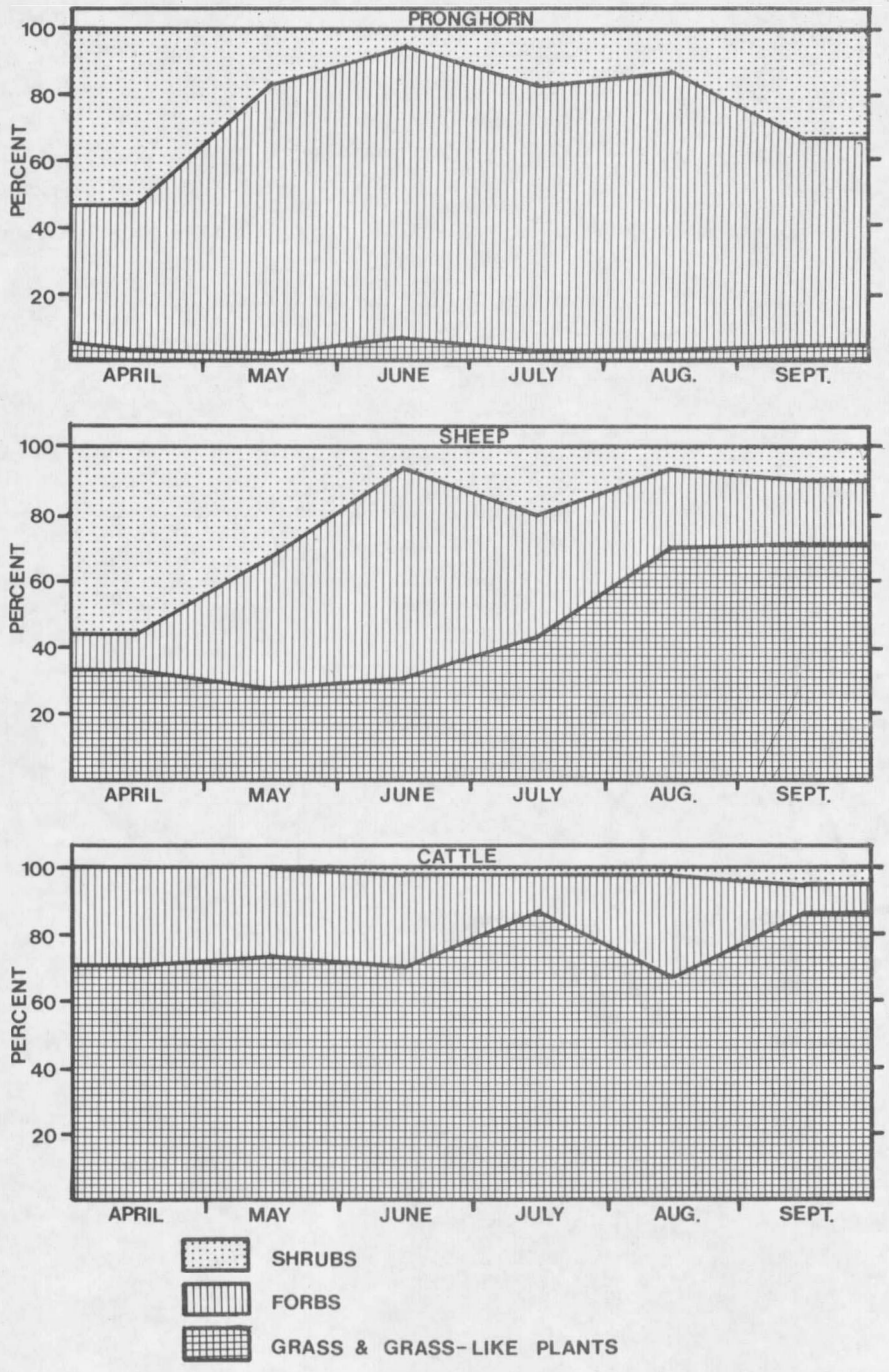

Figure 17. Monthly pronghorn, sheep and cattle forage class use for April-September, 1969.

competition even though similarities of the diets did exist. Food habits of the two were somewhat similar in late spring and early summer but diverged towards the end of summer and by early fall were quite dissimilar. Shrubs were the major item in both diets for late spring and *Artemisia tridentata* was an important forage species that was utilized by both sheep and pronghorns. This is in apparent conflict with Ferrel and Leach (1950) as they indicated that *Artemisia tridentata* was only slightly palatable for sheep. During summer and early fall, forbs were preferred by both sheep and pronghorns, but for both periods remained dominant only in the diet of the pronghorn. Both pronghorns and sheep preferred *Melilotus officinalis* when available; however in summer other forb species were utilized by sheep to a greater extent than was the case with pronghorns. These other species were representative of those forbs found in sheep pastures with a past history of over use. Forage competition was probably greatest in summer when sheep were more widely distributed than during any other period, the joint use of pastures by sheep and pronghorns was also greatest for this period. Due to differences in the early fall diets when sheep shifted from forbs to grass, forage competition during this period was probably slight.

Range use habits of the two were somewhat similar and under different range management conditions those of sheep would no doubt more closely approximate those of pronghorns than those of cattle. Both tended to feed while moving; however pronghorns generally only fed

lightly at any one site, whereas sheep, due to confinement, would continually graze back and forth across an area until all palatable vegetation was removed. Buechner (1950) and others have reported on pronghorn-sheep competition as related to forage consumption. All indicate that competition does occur, but lack of agreement concerning severity is prominent.

The aspect of pronghorn-sheep competition which was probably the most important was the pronghorn withdrawal from 14.7 percent of the study area due to the non-compatible relationship which existed between the two species. The severity of this relationship is no doubt related to the size of the pasture, duration and intensity of sheep use and past grazing history of the area involved. Odum (1953) stated that inter-specific competition may result in one species forcing another to occupy a different space. Buechner (1950) suggested the same pronghorn aversion for sheep that I observed.

PRONGHORNS AND CATTLE

Broad differences in forage class use and the low percentage of all pronghorns jointly occupying pastures with cattle for the late spring period suggested little opportunity for competitive interaction. The major item in the spring diet of cattle was *Agropyron smithii* (64 percent) whereas for pronghorns, two shrubs, *Artemisia cana* and *A. tridentata* were dominant (31 percent of the spring diet). The same

two forbs, *Lomatium foeniculaceum* and *L. macrocarpum*, were preferred by both animals. General observations indicated adequate supplies of these two species during the late spring period.

Summer and early fall were seasons when direct pronghorn-cattle competition would have been the greatest from the standpoints of land use and forage use. Twenty-one, 58 and 42 percent of all pronghorns were observed in pastures with cattle for late spring, summer and early fall, respectively. Competition for forbs during these two periods was probably greatest as broad differences existed in degree of use of the other two forage classes. The dominant item in the summer and early fall diets of cattle was *Agropyron smithii* (48 and 68 percent, respectively). For pronghorns, it was *Melilotus officinalis*, which made up 21 and 47 percent of the summer and fall diets, respectively. This forb was preferred by both animals during these periods. Due to heavy use of this species its availability by the end of summer, except on certain sites, was very limited. However, availability of all forbs generally began to decrease around mid-summer and at this time cattle began to utilize other more available forage plants, mainly grasses. Pronghorns continued to utilize large quantities of forbs due to preferences and to their relatively unrestricted mobility which allowed them to search out areas where forbs were still moderately abundant. This was shown by the increased pronghorn use of the *Agropyron*-Leguminosae-*Gutierrezia* habitat type as the growing season progressed.

The compatible relationship which existed between pronghorns and cattle as shown by pasture use and association data, plus the differences in general food habits indicated that pronghorns and cattle can and will use the same pasture and the joint use will probably result in a more efficient use of the range forage plants.

Buck (1947), Buechner (1947 and 1950) and others have indicated that pronghorn-cattle competition is minor. Most of these evaluations of competition have been based primarily on forage consumption and forage class use.

APPENDIX

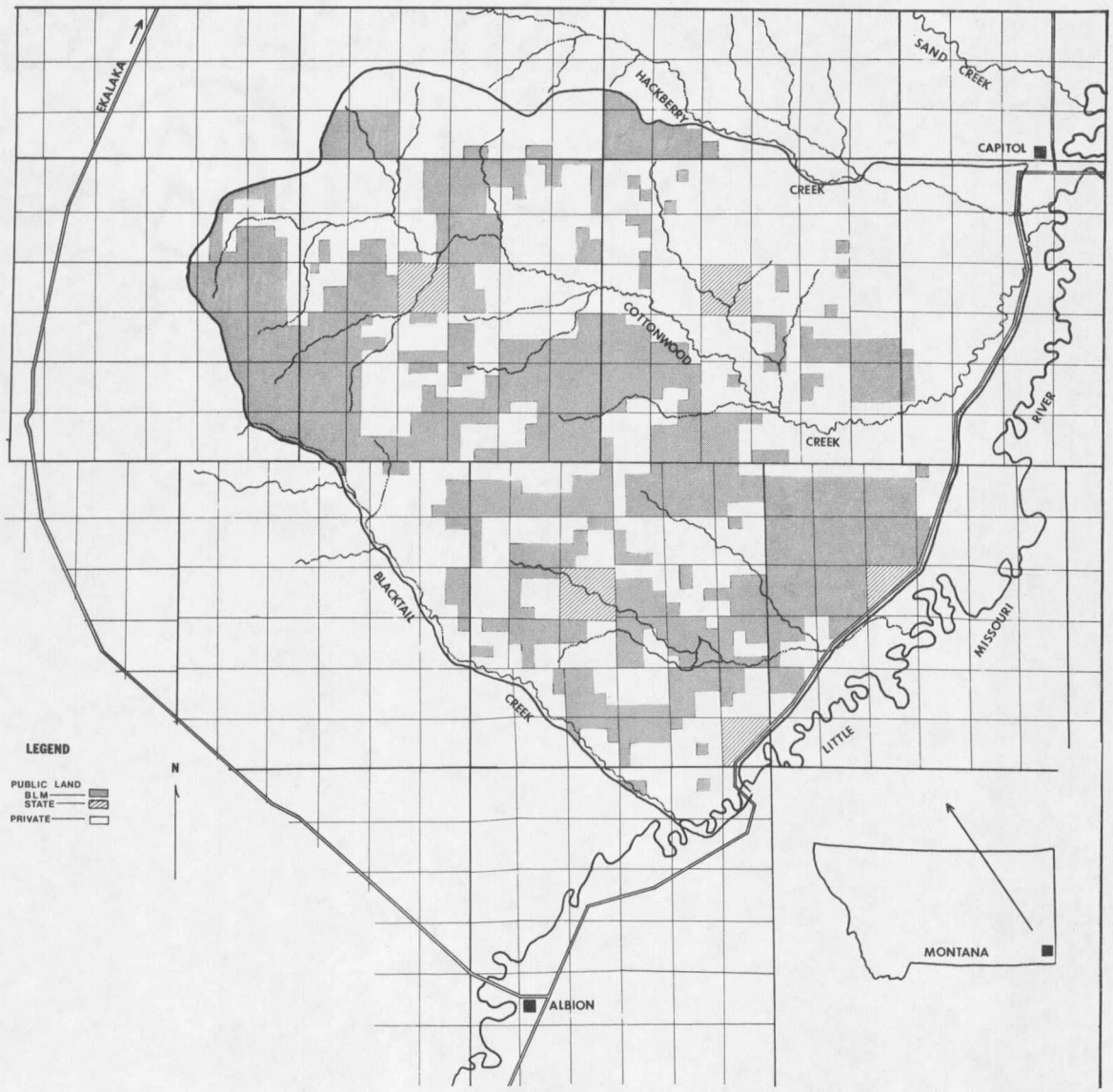

Figure 18. Study area showing land ownership.

TABLE 18. MONTHLY CLIMATOLOGICAL DATA OBTAINED BY AVERAGING RECORDS FROM THE UNITED STATES DEPARTMENT OF COMMERCE WEATHER STATIONS AT ALBION, LOCATED AT THE SOUTHEAST EDGE OF THE AREA AND RIDGEWAY, LOCATED AT THE NORTHWEST EDGE OF THE AREA.

		TEMPERATURE IN DEGREES FAHRENHEIT							PRECIPITATION IN INCHES		
Year	Month	Av. Max.	Av. Min.	Av.	10-Year Average 1958-67	Departure From 10-Yr. Av.	High	Low	Total	Departure From Normal 1958-67 Av.	Normal Average 1958-67
1969	April	64.3	32.1	48.3	42.1	+6.2	81.0	14.0	1.56	+0.12	1.44
	May	72.7	37.8	55.3	53.6	+1.7	94.5	25.5	0.72	-1.53	2.25
	June	71.3	43.3	57.3	62.7	-5.4	93.5	28.0	3.56	+0.63	2.93
	July	84.3	52.3	68.4	70.0	-1.6	95.0	43.0	3.19	+1.35	1.84
	August	90.8	57.8	74.3	68.8	+5.5	102.0	42.5	0.45	-0.62	1.07
	Sept.	79.3	47.7	63.5	56.5	+7.0	97.0	M	T	-1.37	1.37
Total									9.48	-1.42	10.90
1968	April	55.7	23.6	39.7	42.1	-2.4	84.5	00.5	0.72	-0.72	1.44
	May	63.3	36.3	49.8	53.6	-3.8	79.0	20.0	1.82	-0.43	2.25
	June	73.6	47.7	60.7	62.7	-2.0	94.5	33.0	3.30	+0.37	2.93
	July	84.5	51.2	67.8	70.0	-2.2	96.5	35.5	0.80	-1.04	1.84
	August	82.1	48.6	65.4	68.8	-3.4	97.5	M	2.31	+1.24	1.07
	Sept.	74.4	39.0	56.7	56.5	+0.2	90.0	29.0	0.51	-0.86	1.37
Total									9.46	-1.44	10.90

M = Missing.
T = Trace -- Amount to small to measure.

TABLE 19. LIST OF SCIENTIFIC AND COMMON NAMES OF MOST OF THE GRASSES AND GRASS-LIKE PLANTS, SHRUBS, TREES, FORBS AND CACTI FOUND ON THE STUDY AREA.

Scientific Name	Common Name
GRASSES AND GRASS-LIKE PLANTS	
Agropyron cristatum	Crested Wheatgrass
Agropyron desertorum	Crested Wheatgrass
Agropyron smithii	Bluestem
Agropyron spp. (in addition to above)	Wheatgrass
Andropogon scoparius	Little Bluestem
Avena sativa	Oats
Beckmannia syzigachne	American Slough Grass
Bouteloua gracilis	Blue Grama
Bromus japonicus	Japanese Chess
Bromus tectorum	Downy Chess Brome
Buchloe dactyloides	Buffalo Grass
Calamovilfa longifolia	Prairie Sand Reedgrass
Carex filifolia	Threadhead Sedge
Carex spp. (in addition to above)	Sedge
Distichlis stricta	Desert Saltgrass
Elymus canadensis	Canada Wildrye
Festuca octoflora	Six-weeks Fescue
Hordeum jubatum	Foxtail Barley
Koeleria cristata	Junegrass
Muhlenbergia cuspidata	Plains Muhly
Phleum pratense	Timothy
Poa secunda	Sandberg Bluegrass
Poa spp. (in addition to above)	Bluegrass
Schedonnardus paniculatus	Tumblegrass
Spartina pectinata	Prairie Cordgrass
Sporobolus airoides	Alkali Dropseed
Stipa comata	Needle-and-Thread
Stipa viridula	Green Needlegrass
SHRUBS AND TREES	
Artemisia cana	Silver Sagebrush
Artemisia tridentata	Big Sagebrush
Atriplex nuttallii	Nuttall Saltbush
Chrysothamnus viscidiflorus	Green Rabbitbrush
Eurotia lanata	Winterfat
Gutierrezia sarothrae	Broom Snakeweed
Pinus ponderosa	Ponderosa Pine
Populus deltoides	Plains Cottonwood

TABLE 20. (CONTINUED)

Scientific Name	Common Name
SHRUBS AND TREES (continued)	
Prunus virginiana	Chokecherry
Rhus trilobata	Skunkbrush Sumac
Rosa spp.	Rose
Salix spp.	Willow
Sarcobatus vermiculatus	Greasewood
Shepherdia argentea	Buffalo-Berry
Suaeda fruiticosa	Shrubby Seepweed
Symphoricarpos occidentalis	Western Snowberry
FORBS	
Achillea millefolium	Yarrow
Allium textile	Onion
Antennaria parvifolia	Small-Leaf Pussytoes
Arnica fulgens	Arnica
Artemisia frigida	Fringed Sagewort
Artemisia longifolia	Longleaf Sagebrush
Artemisia ludoviciana	Cudweed Sagewort
Asclepias speciosa	Showy Milkweed
Aster canescens	Hoary Aster
Aster falcatus	Aster
Astragalus bisulcatus	Two-Grooved Milkvetch
Astragalus canadensis	Canada Milkvetch
Astragalus cibarius	Milkvetch
Astragalus gilviflorus	Three-Leaved Milkvetch
Astragalus gracilis	Milkvetch
Astragalus lotiflorus	Milkvetch
Astragalus missouriensis	Missouri Milkvetch
Astragalus scaphoides	Milkvetch
Astragalus spatulatus	Tufted Milkvetch
Astragalus striatus	Prairie Milkvetch
Atriplex argentea	Silverscale Saltbush
Atriplex dioeca	Saltbush
Atriplex patula	Spear Saltbush
Bahia oppositifolia	Opposite-Leaf Bahia
Besseya wyomingensis	Kittentail
Calochortus nuttallii	Mariposa Lily
Camelina microcarpa	Littlepod False-Flax
Castilleja sessiliflora	Indian Paintbrush
Centaurium exaltatum	Great Basin Century
Chaenactis douglasii	Douglas Dusty Maiden
Chenopodium album	Lamb's Quarter

TABLE 20. (CONTINUED).

Scientific Name	Common Name
FORBS (continued)	
Chenopodium capitatum	Strawberry Blite Goosefoot
Chenopodium leptophyllum	Narrowleaf Goosefoot
Chrysopsis villosa	Golden-Aster
Cirsium undulatum	Wavyleaf Thistle
Collomia linearis	Narrowleaved Collomia
Comandra umbellata	Pale Bastard Toadflax
Convolvulus sepium	Large Bindweed
Crepis modocensis	Hawksbeard
Crepis runcinata	Dandelion Hawksbeard
Cryptanthe bradburiana	Miner's Candle
Descurainia pinnata	Pinnate Tansy Mustard
Descurainia sophia	Flixweed Tansy Mustard
Echinaceae pallida	Purple Coneflower
Epilobium paniculatum	Panicled Willow-Herb
Erigeron pumilus	Daisy
Eriogonum annum	Annual Eriogonum
Eriogonum flavum	Yellow Eriogonum
Eriogonum multiceps	Eriogonum
Erysimum asperum	Plains Wallflower
Euphorbia esula	Leafy Spurge
Euphorbia serphyllifolia	Thyme-Leaved Spurge
Euphorbia serpens	Serpent Spurge
Gaura coccinea	Scarlet Gaura
Gilia congesta	Densely Flowered Gilia
Glycyrrhiza lepidota	Wild Licorice
Grindelia squarrosa	Curlcup Gumweed
Halimolobos virgata	Mustard
Haplopappus lanceolatus	Lance Goldenweed
Haplopappus multicaulis	Branched Goldenweed
Haplopappus nuttallii	Nuttall Goldenweed
Haplopappus spinulosus	Spiny Goldenweed
Helianthus laetiflorus	Showy Sunflower
Helianthus maximiliani	Maxamilian Sunflower
Helianthus petiolaris	Prairie Sunflower
Hymenoxys acaulis	Hymenoxys
Iva axillaris	Poverty Weed
Kochia scoparia	Kochia
Kuhnia eupatoriodes	Kuhnia
Lactuca pulchella	Blue Lettuce
Lactuca serriola	Lettuce
Lappula redowskii	Western Stick Tight

TABLE 20. (CONTINUED).

Scientific Name	Common Name
FORBS (continued)	
Lepidium densiflorum	Prairie Pepperweed
Lesquerella alpina	Alkaline Bladderpod
Lesquerella ludoviciana	Silver Bladderpod
Leucocrinum montanum	Mountain Star Lily
Liatris punctata	Dotted Blazingstar
Linum rigidum	Stiffstem Flax
Lomatium foeniculaceum	Lomatium
Lomatium macrocarpum	Large-Fruited Lomatium
Lupinus argenteus	Silvery Lupine
Lupinus pusillus	Rusty Lupine
Lygodesmia juncea	Rush Skeleton Weed
Medicago sativa	Alfalfa
Melilotus officinalis	Yellow Sweetclover
Mertensia viridis	Greenleaf Bluebell
Microseris cuspidata	Microseris
Microsteris gracilis	Microsteris
Monarda fistulosa	Horsemint
Monolepis nuttalliana	Nuttall Monolepis
Musineon divaricatum	Musineon
Oenothera caespitosa	Tufted Evening Primrose
Oenothera nuttallii	Nuttall Evening Primrose
Orthocarpus luteus	Yellow Owl Clover
Oxytropis besseyi	Bessey Pointvetch
Oxytropis campestris	White Small-Flower Pointloco
Penstemon albidus	White Penstemon
Penstemon angustifolius	Narrowleaf Penstemon
Penstemon eriantherus	Fuzzytongue Penstemon
Penstemon spp. (in addition to above)	Penstemon
Petalostemon candidum	White Prairie-Clover
Petalostemon purpureus	Purple Prairie-Clover
Phlox hoodii	Hoods Phlox
Plagiobothrys scouleri	--
Plantago elongata	Slender Plantain
Plantago purshii	Wooly Plantain
Polygala alba	White Milkwort
Polygonum aviculare	Prostrate Knotweed
Polygonum ramosissimum	Bushy Knotweed
Psoralea argophylla	Silverleaf Scurfpea
Ratibida columnifera	Prairie Coneflower
Rumex crispus	Curl Dock
Rumex obtusifolius	Blunt-Leaved Dock

TABLE 20. (CONTINUED)

Scientific Name	Common Name
FORBS (continued)	
Salsola kali	Russian Thistle
Sedum lanceolatum	Lanceleaf Stonecrop
Sedum stenopetalum	Yellow Stonecrop
Senecio canus	Woolly Groundsel
Sisymbrium altissimum	Tumblemustard
Solanum rostratum	Buffalo Bur
Solidago missouriensis	Goldenrod
Solidago mollis	Goldenrod
Solidago rigida	Goldenrod
Sphaeralcea coccinea	Scarlet Globemallow
Suaeda depressa	Pursh Seepweed
Taraxacum laevigatum	Smooth Dandelion
Taraxacum officinale	Common Dandelion
Thermopsis rhombifolia	Prairie Thermopsis
Thlaspi arvense	Fanweed
Tragopogon dubius	Common Salsify
Verbena hastata	Swamp Verbena
Vicia americana	American Vetch
Viola nuttallii	Nuttall Violet
Xanthium strumarium	Cocklebur
Zigadenus paniculatus	Foothill Death Camas
CACTUS	
Mammillaria vivipara	Pink Pincushion Cactus
Opuntia polycantha	Plains Pricklypear

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